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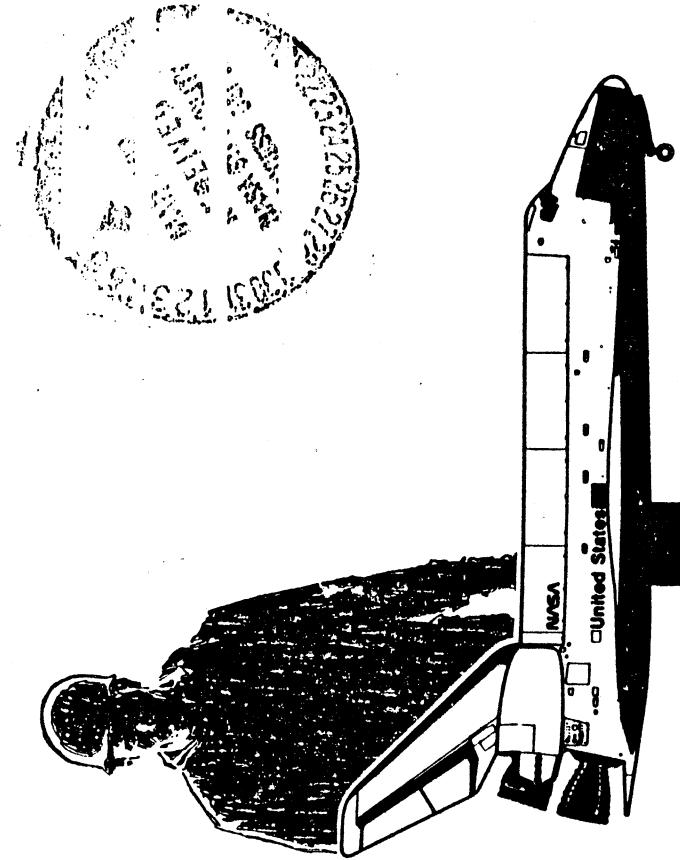
Basic Safety Manual

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PREFACE

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This handbook prescribes the basic safety requirements applicable to NASA Headquarters and field installations. It provides guidance in preserving NASA resources by avoiding loss of life and reducing injuries, in preventing damage to facilities and property, and controlling mission and test failures. Portions also can be applied to NASA contractor operations within the scope of the contract.

NASA's policy for Safety and Health is published in the Management Directives System, subject-classification numbered series 2710, and program details are in series 1700 for Safety and 1800 for Health.

Comments and questions concerning the contents of the publication should be referred to the National Aeronautics and Space Administration, Attention: Safety Division, Code DS, Washington, DC 20546.

The following NASA Safety Standards are cancelled or incorporated in this handbook:

NSS/MV 1740.2, "NASA Safety Standard for Motor Vehicle Safety Belts."

NSS/MV 1740.6, "NASA Safety Standard for Inflating Tires with Split Rims or Retainer Rings."

NSS/FS 1740.7, "NASA Safety Standard for Handlers of Hazardous Materials."

NSS/GO 1740.8, "NASA Safety Standard for Certification of Personnel Engaged in Potentially Hazardous Operations."

NHB 1700.1(V1) dated July 1969; NMI 1152.60 dated April 24, 1981 and Change 1 dated February 16, 1982; NMI 1712.1A dated October 20, 1980; and NMI 1730.1C dated August 8, 1978; are cancelled and their policies incorporated herein.


Stanley I. Weiss
Chief Engineer

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ORGANIZATION OF THE NASA SAFETY MANUAL

This is the first (A) revision of the NASA Basic Safety Manual, NHB 1700.1(V1). It will be referenced as NHB 1700.1(V1-A). It is being assembled in loose-leaf form to more easily allow for the addition of future chapters and changes or supplements. Field installations and Officials in Charge of Headquarters Offices have the option of either adding supplements to this handbook or developing new documents which incorporate as a minimum, the policy contained herein. Copies of either will be provided to the Director, Safety Division, Code DS.

Follow-on safety volumes developed to expand the subject of a particular chapter will be given the same volume number as the chapter they support. (Example: NHB 1700.1(Y2) is being written to further expand the principles of mishap investigation outlined in Chapter 2.)

Chapters dealing with combined safety and health subjects will be supplemented by handbooks published in the NHB 2700 series.

The paragraphs of this volume are numbered as follows:

<u>1.12-4c(3)(d)</u>	Chapter.....	Paragraph	Sub-paragraphs (as needed)
:	:	:	
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For references within this handbook, the standard method for referencing paragraphs will be as noted above. For references between the volume supplements of this handbook, the volume number followed by the paragraph number will be used (Example: V3, paragraph 1.3-6.) For references in other documents or correspondence, the full numerical notation should be written. (Example: NHB 1700.1(V1-A) paragraph 1.9-6b(4)(c).



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CHAPTER I: BASIC SAFETY MANAGEMENT

1.1 PURPOSE

1. The NASA Basic Safety Manual is the central agency document containing guidelines, instructions, and requirements which define the NASA Safety Program. It is an evolutionary document subject to continuous upgrading and change. It is intended to serve as a general framework to structure the more specific and detailed requirements for Headquarters, Program, and Field Installations Directors.
2. Because safety and health personnel are both concerned with the well being of personnel, safety and health specialists will often find themselves working together toward the same goal. Although this is primarily a safety handbook, some health is included to assist field installation safety personnel in interactions with the health program. Additional health guidance can be found in documents provided by the NASA Occupational Health Office.
3. Additional safety documents will be formulated and issued in order to convey instructions which are either too detailed for inclusion in this handbook or which require special distribution and use.

1.2 APPLICABILITY

The NASA Basic Safety Manual is applicable to all personnel employed by NASA, to all work conducted under the responsibility of NASA, and to all equipment and property managed by NASA. For contractors, it is applicable (as appropriate) through contract clauses in conformance with the NASA Procurement Regulation (e.g., Part 1, Subpart 52 and Part 14, Subpart 6). It applies to Jet Propulsion Laboratory (JPL) as directed by NMI 1410.3, "Application of the NASA Management Directives System to the Jet Propulsion Laboratory." Non-NASA, noncontractor personnel will follow the provisions of this handbook when on NASA property.

1.3 BACKGROUND AND BASIC POLICY

1. The success of a safety program is dependent on those same criteria as the success of any other program—the desire of management to see it succeed and the dedication of all employees in performing their assigned responsibilities. The steps begin with proper planning in the initial concept, including the allocation of adequate resources, time, people, and money, and end with proper employee motivation, training, and supervision.

The lack of success of a safety program can be objectively measured by the number of near misses, mishaps to property, lost workdays, lost time injuries and illnesses, and fatalities which occur in the workplace. These, of course, result most often in capital replacement costs, operational delays, lost productivity, short and long term financial costs to the agency, medical expenses, personal and family tragedy, or a combination thereof.

2. It is NASA policy to:
 - a. Avoid:
 - (1) Loss of life.
 - (2) Injury to personnel.
 - (3) Damage to or loss of equipment or property.
 - (4) Mission or test failures.
 - (5) Undue risk.
 - b. Promote safety by instilling safety awareness in all NASA employees and contractors.
 - c. Utilize an organized and systematic approach to identify and control hazards, ensuring that safety factors are fully considered from conception to completion of all agency activities.

1.4 IMPLEMENTATION GUIDELINES

1. GENERAL

- a. NASA will take all practical steps to avoid the loss of life or injury to personnel, property loss, or mission or test failures. Accordingly, NASA will support and maintain a well-defined safety program and organization. Safety will be accomplished as a line organization function as an integral part of each supervisor's responsibilities, with timely monitoring, surveillance, and support from the professional safety staffs. It is incumbent upon all NASA personnel to act responsibly in matters of safety and to encourage contractors to conduct their activities in a safe and responsible manner. Strong safety relationships will be encouraged at all levels. Management follow-up techniques will be emphasized. Close working relationships both internally and with contractors will be sought. Cognizant NASA safety personnel will be provided access to all NASA operations unless there are compelling reasons for denial of access in directive form. Cognizant safety personnel are empowered to stop operations which represent clear, present, and unwarranted danger to employees including contractor employees, and the public, or NASA property using red tag procedures or stop work procedures. Such operations shall not be resumed until such conditions or procedures are abated or corrected.
- b. Particular attention is to be directed toward situations involving multiple offices, contractors, shifts, and installations. In all situations, safety responsibilities are to be clearly defined and the communication of safety information among operational elements is to be emphasized.

- c. Emphasis is to be placed on knowledge of hazards, the elimination or control of hazards, and risk assessment. Risk evaluations will be applied in the decisionmaking process bearing on the safety of personnel and equipment. The scope or depth of these evaluations can be tailored in keeping with the complexity of the program or system being analyzed. System safety principles will be an integral part of the risk assessment of the occupational setting.
 - d. Managers and supervisors at every level within NASA have a responsibility to identify hazards, unsafe situations and practices, and to take steps to assure safety of operations under their supervision.
 - e. The NASA Safety Program will be action oriented as opposed to an attitude of reaction. Emphasis will be placed on safety preplanning and mishap prevention as well as corrective action after the fact. Emphasis is to be placed on adequate safety control, both in-house and in contractor operations. Constant improvement is to be sought in the overall management of safety. Management interests and involvement must be evident from top to bottom.
 - f. Useful lines of communication will be established with other disciplines, such as product and quality assurance, occupational health, human factors engineering, biological engineering, etc.
2. SPECIFIC
- Officials-in-Charge of Headquarters Offices, Field Installation Directors, and program managers have the responsibility to assure that:
- a. The safety organization is placed at a high enough level to ensure that the safety review function is done independently, the safety responsibilities of each organizational element are properly emphasized and accomplished, and adequate resources are available to support the safety efforts.
 - b. Policies, plans, procedures, and standards which define the particulars of the safety program are established, documented, maintained, communicated, and implemented to provide for the proper or adequate protection of personnel, property, material, equipment, and facilities of NASA, other agencies, and the public.
 - c. Contractor operations are reviewed and evaluated for compliance with the safety provisions of the contract and good safety practices. These results will be provided to fee award boards, where applicable (see Chapter 3).
 - d. An effective risk assessment system is developed and used to identify potential hazards or failure modes for all projects or operations; the potential of the hazards or failures are analyzed and categorized; detailed operating and emergency procedures or administrative

controls are developed to overcome or reduce the hazards or the effects of the failures if they cannot be eliminated or reduced to acceptable levels by design, engineering changes. The test procedures, operational manuals, operating procedures, and other manuals and procedures are modified to reflect the emergency or reduced risk procedures. For further information on risk assessment see paragraph 1.12 of this handbook and the handbook "Occupational Safety and Health Programs," NHB 2710.1.

- e. Protective clothing and equipment, warning signs, caution labels, etc., are provided and used if the hazards cannot be reduced to acceptable levels by the use of design, engineering changes, or administrative controls. The order of priority will be (1) design the hazard out of the systems (to include substitution of a less hazardous substance/material), (2) incorporate engineering changes to the system to eliminate or control the hazard, (3) install caution or warning devices, (4) apply administrative controls, (5) use protective clothing and equipment.
- f. Qualified and trained personnel and appropriate procedures are used in the performance of potentially hazardous and/or critical technical operations (see Chapter 6). Where the risk dictates, personnel will work in pairs.
- g. All accidents, incidents, mission or test failures, or other mishaps, are promptly investigated, their causes identified, corrective measures required to prevent their recurrence implemented, and meaningful information communicated to others to assist in mishap prevention (see Chapter 2).
- h. Design Reviews (DR), Flight Readiness Reviews (FRR), Test Readiness Reviews (TRR), Operational Readiness Reviews (ORR), or other equivalent formal reviews are conducted prior to start up of operations for ground facilities, manned and unmanned launch operations, aircraft flight programs, and acceptance testing of experimental facilities and hardware having significant risk to persons or property. These reviews shall be conducted with participation by personnel with pertinent technical and management experience and expertise. The reviews shall assure that projects/programs include an organized system to identify hazards and to assure control of associated risks. Management will make all decisions to accept risk. The level of management approval will be dependent on the probability of occurrence and severity of the hazard. Decisions to accept risk will be documented and will require coordination by the cognizant safety official and the project manager. The reviews will also ensure the development of up-to-date operating manuals and/or procedures and that appropriate safety provisions have been included in all operating documents.
- i. Significant anomalies which occur in essential subsystems during final preparation for launch, flight, or operational use are reviewed

- and resolved. All prior anomalies on that particular subsystem will be reviewed in light of the most recent anomalies even though they have been previously corrected or explained.
- j. Training is provided to all personnel in basic safety principles, on their individual responsibilities in the safety program, and on the specific safety requirements applicable to specific job hazards (see Chapter 4).
 - k. Periodic safety talks, briefs, and meetings among all personnel are encouraged. Managers and directors will demonstrate their interest in safety by supporting these meetings.
 - l. Regular checks and periodic inspections and evaluations of facilities and operations are performed to determine if employees are being exposed to unacceptable hazards and if they are following safety rules and regulations. The inspections will be performed by qualified personnel at least annually.
 - m. Project planning documents are reviewed and approved from a safety standpoint prior to their implementation. The summary statements will include discussions of compliance or deviations with various safety standards or procedures. Any deviations from standards or established procedures will be documented, reviewed, and justified before construction is implemented.
- #### 1.5 DEFINITIONS OF ORGANIZATIONAL TITLES
1. The titles of Officials-in-Charge of Headquarters Offices, and Field Installation Directors, are used in this manual. The definitions of these titles are contained in NMI 1132.2, "NASA Organization and Definition of Terms."
 2. For individual responsibilities and functions of NASA safety and health management personnel, see NMI 8710.2, "NASA Safety and Health Programs."
- #### 1.6 ADVISORY PANELS, COMMITTEES, AND BOARDS
1. HUMAN RESOURCES
- It is NASA's intent that maximum use be made of the Nation's most competent safety resources. In keeping with this philosophy, consultants, interagency and interdisciplinary panels, and ad hoc committees may be used and may consist of representatives from industry (management and union), universities, and government (management and union), including NASA, and may be employed to review and advise on the needs of the NASA Safety Program.

2. AEROSPACE SAFETY ADVISORY PANEL

- a. The Aerospace Safety Advisory Panel was established by Public Law 90-67 during 1968 to serve as a senior advisory body to the Administrator of NASA.
- b. The following is that portion of Section 6, Public Law 90-67, dealing with Panel functions:

"The panel shall review safety studies and operations plans referred to it and shall make reports thereon, shall advise the Administrator with respect to the hazards of proposed or existing facilities and proposed operations with respect to the adequacy of proposed or existing safety standards and shall perform such other duties as the Administrator may request."

- c. The Panel will be provided with all available information that it may request, as well as unlimited access to all areas during on-site reviews, at both NASA and contractor facilities, as deemed necessary by the Panel and arranged through the Administrator.
- d. See NMI 1156.14, "Aerospace Safety Advisory Panel," for further details.

3. OPERATIONS AND ENGINEERING PANEL (O&E Panel)

- a. The O&E Panel is an internal standing committee reporting to the Chief Engineer. The panel provides technical overview of specifically assigned NASA operations to:
 - (1) Evaluate and recommend a consistent and reasonable program for assuring the continuing operational integrity of NASA test facilities such as wind tunnels, pressure systems, etc., which support research and development (R&D) and programmatic operations.
 - (2) Evaluate operations and engineering technical support systems, problems, and issues at the Centers and provide recommendations to management in these areas.
 - (3) Study technical support systems problem areas and develop alternate solutions and/or methods for arriving at a solution.
 - (4) Support the Chief Engineer on any special assignments the Chief Engineer or his/her designee specifies related to facilities operations and engineering activities.
 - (5) Exchange technical expertise and operational experience among key operating officials.

- b. When matters under the purview of other offices are reviewed, followup action will be delegated to the responsible office.
 - c. NMI 1152.54, "NASA Operations and Engineering Panel," further describes the functions and procedures of the O&E Panel.
4. INTERNAL STANDING COMMITTEE FOR THE ISSUANCE OF PERMITS TO SHIP ROCKET MOTORS, CLASS B EXPLOSIVES, IN A PROPELLIVE STATE OR WITH IGNITERS INSTALLED
- a. This internal committee was formed in 1978 to review and recommend approval of requests from installation and contractor personnel to ship rocket motors containing Class B explosives in a propulsive state or with igniters installed.
 - b. The committee advises the NASA Director, Safety Division, who will issue the shipping permit or reject the request. The NASA Safety Division provides the chairperson and various Headquarters offices provide members.
 - c. See NMI 1152.61, "NASA Internal Standing Committee for the Issuance of Permits to Ship Rocket Motors Containing Class B Explosives in a Propulsive State or With Igniters Installed," for more information.
5. INTERAGENCY NUCLEAR SAFETY REVIEW PANEL
- a. The Interagency Nuclear Safety Review Panel (INSRP) is an interagency panel whose members are designated by the heads of the Department of Defense, Department of Energy, and NASA to review the nuclear safety related aspects of all systems, programs, or hardware associated with the use of radioactive (nuclear) power or heat sources in space.
 - b. The coordinator from each of the three agencies is designated by the head of the agency and is responsible for selecting panel members from his/her agency and appropriate supporting agencies/organizations to participate as panel members, consultants, advisors, or observers.
 - c. The panel has the responsibility of evaluating all aspects of the space missions to determine potential failures which are considered hazardous to people if radioactive material is released.
 - d. The panel prepares an evaluation document for the agency heads for this review and transmittal to the Office of Science and Technology Policy, Office of the President, as part of the support to justify launch approval.
 - e. Negative findings by the INSRP are considered sufficiently serious to cause system modifications to eliminate the particular problem.

1.7 COORDINATION WITH ORGANIZATIONS EXTERNAL TO NASA

1. Liaison should be maintained with other government and private agencies for the purpose of interchanging information. New and different methods and practices that may be beneficial NASA-wide should be brought to the attention of the responsible Headquarters office.
2. Active participation by NASA safety professionals and other NASA officials in various outside job-related activities is encouraged. Examples are functions and committees of the National Safety Council, National Fire Protection Association, Department of Defense Explosive Safety Board, National Academy of Sciences, System Safety Society, American Society of Safety Engineers, etc. Such participation shall be governed by the appropriate directives to include OMB Circular A-119, and instructions issued to implement the circular.

1.8 SAFETY MANAGEMENT INFORMATION

1. GENERAL

Efficient communication of safety information is necessary to meet the needs of safety officials and the managers they support. Every practical means for communicating safety management information and statistics, both orally and in written form, will be pursued by safety organizations throughout NASA. Particular emphasis will be placed on the following communication techniques.

2. INFORMATION THROUGH PARTICIPATION

Safety responsibilities will be defined to include safety participation in critical reviews and events such as hardware design reviews, test program specifications development, readiness reviews, design certification reviews, facility design criteria, approvals, site activation reviews, operational test procedure reviews, aircraft test criteria reviews, source evaluation boards, etc. The safety official will also be a regular participant in the procurement process for the acquisition of hardware or equipment, where safety will be an important consideration (see Chapters 3 and 7). Safety officers and other management officials must cooperate to assure that safety personnel are able to provide the safety scrutiny necessary at the most critical points in each type of operation.

3. INFORMATION THROUGH REVIEW AND EVALUATION

The safety organization will conduct safety management surveys, evaluations and inspections. By careful scheduling and sequencing of evaluations, the safety organization will keep itself thoroughly informed on problems being encountered and the means being used to solve them (see paragraph 1.9).

4. INFORMATION THROUGH REPORTING

- a. Reports of accidents, incidents, failure analyses, identified hazards, mishaps, appraisals, and like items, contain information necessary for developing corrective measures. Individual pieces of data will be collected at contractors' plants and field installations and used directly at those levels. It will be reported up through channels for evaluation and wide distribution subject to applicable security and privacy restrictions. Feedback from the Headquarters on overall NASA performance will be provided via the Annual NASA Mishap and Injury Data Report (Report Control Number 10-0000-00213).
- b. Participation in the Government-Industry Data Exchange Program (GIDEP) (Report Control Number 10-SMIS-00844) is expected. This system enables broad dissemination of safety and quality related discrepancies in equipment and material for purposes of preventing mishaps. Guidance is contained in NMI 5310.1 and NMI 5310.2. See, also, Chapter 7 of this handbook.

5. INFORMATION THROUGH MEETINGS AND CONSULTATIONS

The NASA safety professionals will consult with program personnel to plan and anticipate future safety requirements.

6. FURNISHING OF DOCUMENTS TO NASA HEADQUARTERS

- a. One copy of each installation safety document shall be furnished to the NASA Director, Safety Division. These documents shall serve as reference documents for the development of overall safety policy.
- b. The following documents will be forwarded to the NASA Director, Safety Division, if they contain safety information. Comments may be generated and returned to the installation.
 - (1) Safety analysis reports and hazard analyses as requested.
 - (2) Installation executive safety board documentation (minutes, reports, etc.).
 - (3) Reports from Design Reviews, Flight Readiness Reviews, and Final Acceptance Boards, and other review boards that have safety implications, as requested.
 - (4) Results of internal or external (such as Occupational Safety and Health Administration (OSHA)) overall safety program management reviews.

1.9 SAFETY PROGRAM REVIEWS

1. GENERAL

In addition to normal management surveillance, formal evaluation of the safety program will be accomplished by competent and qualified (as stated in 29 CFR Part 1960) safety personnel through safety surveys, safety evaluations, and in-depth safety inspections. While review of accident reports, statistics, and program documents provide a general indicator of the extent and success of the safety program, objective evaluation visits by the functional safety management officials are required to enhance accident prevention efforts and to strengthen the effectiveness of the safety programs. The specific objectives of these evaluations will be to:

- a. Evaluate the effectiveness of safety program management.
- b. Identify hazards and suggest corrective action.
- c. Determine the adequacy of safety standards and procedures.
- d. Observe compliance with sound safety practices.

2. REVIEW CATEGORIES

For the convenience of designating the degree of formality attached to the safety reviews, three types are designated: safety surveys, formal safety evaluations, and safety inspections. While the objectives of the three are similar, the procedures differ.

- a. Safety Surveys. Surveys are informal staff assistance visits. Specialists and safety personnel will make spot checks and sampling visits and will hold discussions with appropriate levels of management. The prime objective is to assist the organization through evaluation by an outside, objective, and nonproprietary party (third party).
- b. Formal Safety Evaluations. Evaluations are more formal and methodical than surveys; greater depth and more comprehensive coverage of every facet of the activity is expected. An evaluation will be oriented toward an appraisal of the management philosophy and support for the safety program, and of the compliance with existing safety rules and regulations. A written report is usually provided and a written response containing a corrective action plan with milestone dates is usually required.
- c. Safety Inspections. Inspections are the most detailed formal method of review. They consist of a listing of observed problems, violations of safety standards, rules, and procedures by operating personnel and organizational entities, that alone or collectively may indicate that a deeper problem exists. The

deeper problems are addressed during formal program evaluations. The reports of inspections are normally provided to the appropriate management level that is responsible for correcting the violations.

3. SAFETY PROGRAM REVIEW RESPONSIBILITIES

- a. Headquarters. Headquarters will sponsor safety, reliability, and quality assurance evaluations of field installations at least biennially.
- b. Program Personnel. Program personnel have their own needs and requirements for program safety evaluations. These should be coordinated with the NASA Deputy Chief Engineer for Safety, Reliability, and Quality Assurance so overlapping areas of responsibility can be discussed and possibly combined for efficient utilization of resources. The above official will be kept aware of the plans, status, and safety related findings of teams established by program personnel.
- c. Installation Directors
 - (1) Installation Directors or their representatives will schedule safety reviews to assure that all functions and areas within their respective installations and contractor activities receive frequent, and meaningful evaluations. The review of facilities and operations will help ensure safe working conditions and the enforcement of safety standards and requirements. As a minimum, all operations and facilities will be inspected at least annually for safety by qualified personnel. A schedule of inspections will be maintained to ensure total coverage and adequate additional inspections in high hazard areas or locations where mishaps occur regularly. Notification will be made to the appropriate management and employee representative personnel of the schedules unless the reviews will be unannounced.
 - (2) Safety evaluations and inspections of specific hazardous programs, functions, and areas will be conducted periodically according to a scale of priorities determined by the extent of potential hazardous exposure. These areas include aviation operations, space systems, explosive materials, cryogenics, ionizing and nonionizing radiation sources, propellants, and others.
 - (3) An internal review of the safety program will be conducted during the year when no Headquarters review has been scheduled. The planned schedule of Headquarters reviews will be used as a guide for determining the need for an internal review. Results of the review will be provided to the NASA Director, Safety Division.

4. NASA SAFETY PERSONNEL ACCESS

The effectiveness of the safety evaluation program depends on the cooperation between safety and other personnel. The review teams must have complete access to factual information and personnel opinions in order to contribute positively to accident prevention. This requires open disclosure of pertinent information and access to all areas being evaluated. The extent of the coverage required in any review will be determined by the team chief and the relevant safety official. Entrance and exit interviews with local management will be conducted.

5. TEAM COMPOSITIONS

- a. Headquarters Biennial Safety Program Evaluations. Team membership will be from Headquarters offices. Representatives of industry, other government agencies, or other NASA installations may be invited to participate when it is in the best interest of NASA and qualified, impartial assistance can be obtained and is appropriate to the evaluation.
 - b. Other safety reviews. The team composition of other safety reviews will be as determined by the program, installation, office, or management official sponsoring the review. The members qualifications will be consistent with the criteria in 29 CFR Part 1960.

6. PROCEDURES

a. Headquarters Biennial Safety Program Evaluations

- (1) Prior to the scheduled date, the installation will be asked to provide pertinent data to the designated lead office at Headquarters to assist the review team in planning for their review.
- (2) An entrance briefing may be requested by the team chief to familiarize all members with the installation, mission, and to provide specific information to the review team.
- (3) The evaluations will be conducted in a manner consistent with the requirements in 29 CFR Part 1960, as much as is practicable, and will cover other safety concerns of interest to Headquarters. The survey team members should verify their observations and findings with knowledgeable personnel of the installation, including the representatives of the employees, prior to leaving.
- (4) An exit interview will be conducted by the team chief or his/her designee with a senior official or other representative of the installation to discuss the preliminary results of the survey. An information briefing for all

management officials may be held at the discretion of the team chief and installation officials. A draft report will be left at the installation to indicate the preliminary findings, observations, and concerns of the survey team to allow the installation a chance to initiate early abatement procedures or to aid in preparing a coordinated response.

- (5) A formal report will be sent to the Installation Director usually within 45 days indicating corrective action required. An initial response from the installation will be required within 30 days and a formal schedule will be established for subsequent milestone responses. Inaccuracies or errors in the formal report will be resolved in the initial correspondence between Headquarters and the installation. When all findings and discrepancies have been satisfactorily resolved, the survey report will be closed out.
- b. Other safety reviews. For other reviews, (conducted by local or Headquarters officials) the management official sponsoring the review will determine the level of formality, procedures, and the need for reviewing abatement procedures and corrective actions for the noted discrepancies. Guidance provided in 29 CFR Part 1960 will be followed concerning the conduct of the inspections. Separate occupational health reviews are conducted by occupational health officials locally and from Headquarters. Aviation safety will be covered under the NASA Intercenter Aircraft Operations Panel reviews (see NMI 1152.47).

1.10 EMERGENCY PLANNING

1. GENERAL

Emergency plans are to be in place and discussed with the appropriate personnel and exercised periodically for all NASA activities so that reaction to emergency situations is rapid and effective. Such plans will cover national emergencies and disasters, mishaps, and the communication of information.

2. NATIONAL EMERGENCIES AND DISASTERS

- a. The NASA Emergency Plan is part of the government-wide program to develop and maintain readiness and preparations for emergencies ranging from fires and civil riots to a full-scale military attack on the United States. "The NASA Emergency Preparedness Program," NMI 1040.3, explains how the above situations affect NASA personnel and facilities. It provides guidance on responses to minimize injury or property damage. The guidance for developing this plan is furnished by the General Services Administration (GSA) in 41 CFR Part 101.
- b. This program is the responsibility of the Associate Administrator for Management.

- c. Installation Directors are responsible for preparing their organizations to effectively handle emergencies and disasters and for developing the installation emergency plan.

1.11 NASA SAFETY STANDARDS

For guidance on the development and adoption of NASA and OSHA or other regulatory standards, see the NASA handbook, "Occupational Safety and Health Programs," NHB 2710.1. For unique operations involving equipment and methodology not addressed in the OSHA standards, procedures and standards may be developed by the installation to complement or supplement the OSHA standards. Guidance for obtaining OSHA approval of these is also in the same handbook, NHB 2710.1.

1.12 RISK ASSESSMENT

The decision to assume a risk is a management responsibility and should be based on all relevant factors. The potential severity or probability of a mishap should be a major consideration in that decision.

1. DEFINITIONS

NASA hazardous conditions or operations will be assigned a severity and probability index based on the following:

- a. **Severity.** An assessment of the worst potential consequence, defined by degree of injury, illness, or property damage which could occur. Severity classification will be identified as follows:

- (1) Class I - Catastrophic—may cause death or major system destruction.
- (2) Class II - Critical—may cause severe injury, severe occupational illness, or major property damage.
- (3) Class III - Marginal—may cause minor occupational illness or property damage.
- (4) Class IV - Negligible—probably would not affect personnel safety or health, but is a violation of specific criteria.

- b. **Probability.** The likelihood that an identified hazard will result in a mishap based on an assessment of such factors as location, exposure in terms of cycles or hours of operation, and affected population. Probability will be estimated as follows:

- (1) Estimate A - Likely to occur immediately.
- (2) Estimate B - Probably will occur in time.

- (3) Estimate C - May occur in time.
- (4) Estimate D - Unlikely to occur.

2. RISK ASSESSMENT CODES

The overall assessment of risk of a NASA hazardous operation will be based on both the severity class and probability estimate. A single number Risk Assessment Code (RAC) will be assigned to each deficiency code as shown in the matrix in Figure 1. This does not preclude the use of locally developed systems for risk assessment for local purposes only.

		Probability Estimate			
		A	B	C	D
Severity Class	I	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	3	4	5	6

Figure 1

RAC's 1 will be considered imminent danger and require immediate attention and initiation of abatement procedures. RAC's 2 will be considered serious and require priority attention. All RAC's 3-6 are nonserious, however, they establish a scheme for prioritizing for corrective action.

1.13 WAIVERS

Waivers to requirements set forth in this document require the approval of NASA Headquarters. Requests for waivers will be submitted to the NASA Director, Safety Division, for forwarding to or coordinating with the responsible Headquarters office. Waiver requests will be accompanied by full justification, including reasons for noncompliance, alternative procedures to assure safety, and the expected duration of the waiver. Headquarters will normally process waiver requests in 45 days. Specific deviations from safety standards will be processed in accordance with the NASA handbook, NHB 2710.1, "Occupational Safety and Health Programs."

1.14 SAFETY MOTIVATION

1. INTENT

NASA intends to motivate its employees and its contractors in matters of safety.

2. OBJECTIVES

The major aims of the safety motivation effort will be toward increasing the overall safety and general mission success. Guidelines include the following:

- a. Motivate all personnel to improve their job performance and to eliminate all work defects and unsafe practices.
- b. Relate the quality of products and services to safety.
- c. Relate safety to reduction of cost.
- d. Promote awareness of safety requirements and practices.
- e. Reward contributions to safety.
- f. Promote an attitude in which near-miss situations are promptly publicized, as an accident-prevention means.

3. RESPONSIBILITIES

In order to assure the success of the NASA safety motivation effort, responsibilities to encourage and maintain the development of the program are assigned to all management levels throughout the agency. This supporting effort is needed to achieve the desired NASA safety posture at all levels.

1.15 SAFETY ASPECTS OF NEW TECHNOLOGY

1. During NASA activities new safety related technical knowledge is gained. As this knowledge is refined, it should be recorded in technical reports, accident reports, technical papers, and disseminated and/or applied. To accomplish this, papers, theses, and reports should be presented at professional seminars discussing the safety aspects of new technology to encourage the broadening of the technical data base.
2. Through close cooperation and coordination with the appropriate Headquarters offices, greater use of new safety-related technology can be made more available to industry and other agencies.

CHAPTER 2: MISHAP REPORTING, INVESTIGATING, AND RECORDKEEPING

2.1 GENERAL

1. PURPOSE

This chapter further expands the policy contained in NMI 8621.1 for reporting, investigating, and documenting the occurrences, causes, and corrective action required for mishaps (incidents, accidents, test failures, and mission failures) that may occur during NASA operations when NASA personnel, contractor personnel, or the public are involved and/or NASA property is involved.

2. BASIC POLICY

With respect to all mishaps, it is NASA policy to:

- a. Take all reasonable and proper actions to limit or prevent injury to personnel and damage to or loss of equipment and property.
- b. Report the occurrences to appropriate installation and Headquarters offices in a timely manner and in compliance with this chapter.
- c. Conduct investigations of all mishaps to determine the actual or probable cause, take appropriate actions to avoid recurrence, and document and disseminate relevant information so others can learn from the findings. Mishap investigations will be conducted separately from any collateral investigation conducted for the purpose of determining fault or disciplinary actions.

3. REFERENCES

- a. USAF-NASA Agreement for Joint Space Program Accident Investigations dated April 4, 1966.
- b. USAF-NASA Agreement for Joint Aircraft Accident Investigations dated March 13, 1968.
- c. Navy-NASA Agreement for Joint Aircraft Accident Investigations dated April 19, 1974.
- d. Occupational Safety and Health Act of 1970, Executive Order 12196, and 29 CFR Part 1960.
- e. NMI 8621.1, "Mishap Reporting and Investigating" dated February 26, 1982 (being revised).

2.2 DEFINITIONS

1. NASA MISHAP

Any unplanned occurrence, event, or anomaly that may be classed as a NASA accident (Type A or B), incident, or mission or test failure.

2. TYPE A ACCIDENT

A mishap causing death, disabling injury to five or more persons, damage to equipment or property of \$250,000 or greater, or destruction of an aircraft or space hardware (Investigation Board required).

3. TYPE B ACCIDENT

A mishap causing disabling, injury to four or fewer persons or damage to equipment or property of \$25,000 or greater, but less than \$250,000 (Investigation Board as appropriate).

4. MISSION FAILURE

Any accident, incident, occurrence, event, or anomaly of such a serious nature that it significantly delays a launch, jeopardizes a mission, prevents accomplishment of a major mission objective, or results in a premature mission termination (Investigation Board as appropriate).

5. TEST FAILURE

An event which jeopardizes a test, prevents accomplishment of major test objectives, causes premature test termination, or destroys test hardware, test stands, or monitoring equipment. Test failures will generally result in monetary losses of \$25,000 or more or have significant public or political visibility. When low cost models and other test items, which are specifically designed to meet special test conditions where damage or loss is likely to occur, are damaged or destroyed, the circumstances will largely determine if it is a test failure or an expected or likely result of the test. When a part or assembly fails without significant monetary loss or program delay, this will not be considered a test failure by this definition.

6. INCIDENT

A mishap of less-than-accident severity to personnel or property; more specifically, where injury to personnel is judged to be sufficiently minor as to result in no time loss beyond the day of the mishap or where damage to equipment or property is construed to be less than \$25,000, but there may still be a significant amount of interest generated. Routine failures due to normal wear and tear on equipment are not considered incidents unless the failure results in additional damage.

7. NEAR-MISS

A near-miss may be described as an occurrence in which there may be no injury, property damage, nor interruption to production, but which possesses high potential for a mishap. It may be reported to Headquarters if considered significant by the field installation personnel.

8. COSTS

Direct costs of repair, retest, delays, replacement, or recovery of NASA material, including hours, material, and contract costs, but excluding indirect costs of cleanup, investigation, injury, and normal operational delay.

9. HEADQUARTERS REPORTABLE MISHAP

A mishap that, due to its severity or dollar loss, requires timely notification to Headquarters. Normally this includes Type A, Type B (except those involving minor occupational injuries where individual employees are involved and which are reported quarterly on the OSHA 102F report), mission failures, test failures, or any other mishap that may cause a significant negative public reaction or program delay.

10. RECORDABLE INJURY

An occupational death, injury or illness that must be recorded on the Log of Occupational Injuries and Illnesses, OSHA Form 100F. These are every occupational death; every nonfatal occupational illness; and those nonfatal occupational injuries which involve one or more of the following: loss of workdays, loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid).

11. ACTION CENTERS

An emergency center set up by the appropriate installation official or program official to coordinate all communications, responses, and other actions for mishaps that have international, national or regional implications, high visibility, or major public interest.

2.3 RESPONSIBILITIES

1. All NASA personnel shall report mishaps to the appropriate field installation personnel and Headquarters offices (if a Headquarters reportable mishap) in a timely manner. Field installation safety directors/officials and the Director, Safety Division, are the primary focal points for initial reporting. Program Managers and other personnel will immediately report mishaps to their initial focal points, unless they have been notified through the safety notification channel. Also, installation safety and NASA Safety Division personnel shall promptly notify program and project personnel of mishaps related to their responsibilities.

2. Program Associate Administrators and Field Installation Directors are responsible for ensuring that plans and other arrangements exist to cope with mishaps within their respective jurisdictions and for reporting mishaps, investigating them, assuring corrective action is taken, and reporting the results to the appropriate authorities. Plans and arrangements must be consistent with applicable provisions of this handbook.
3. Field Installation Directors will provide a list to the Director, Safety Division, of at least 10 management and technical specialists who can be designated, as needed, to serve on investigation boards as members, chairpersons, and/or advisors. This list of specialists shall be reviewed and updated at least annually. Information concerning expertise, experience, and other related data should be included for each specialist. This list may be used at the field installation or Headquarters level to recommend individuals to serve on investigation boards or participate on NASA and/or non-NASA boards and committees. If necessary experts and/or experienced personnel are not included on the list or those listed have other priority assignments and are not available for a particular investigation, other specialists will be designated. Also, if specialists are available at the installation, they can be used instead of others on the list.

2.4 PROCEDURES FOR REPORTING NASA MISHAPS

1. INITIAL FOCAL POINTS

- a. All NASA mishaps are reportable. The severity of the mishap will determine the level of reporting at the local level and the need to notify Headquarters.
- b. At the field installation, to simplify the reporting process, the field installation safety office will be designated as the focal point for all mishap reporting. Procedures will be developed to provide for proper communications between medical, emergency, security, supervisory personnel and the safety office.
- c. At Headquarters, the Director, Safety Division, is the initial notification point for all mishaps reported from field installations. The Director, Safety Division, will also be so listed on all Headquarters developed and approved contingency plans.
- d. Near-miss, low cost and minor first aid occurrences will be reported to the immediate supervisor. Supervisors will determine whether to report the circumstances to the safety office based on the injury/damage potential and the possible existence of other similar hazards center-wide.
- e. The Director, Safety Division, will maintain and periodically publish a NASA Headquarters mishap notification list to assist in informing officials of significant mishaps occurring in NASA operations. Copies will be distributed to the field installations to assist them in the reporting process.

- f. If sabotage is suspected, the nearest NASA security office will also be notified. If criminal neglect or other legal violations are suspected, the nearest NASA Inspector General Office will be notified.

2. REPORTING RESPONSIBILITIES

- a. **Employees.** All personnel involved in or observing a NASA mishap should (after taking appropriate emergency action) notify the nearest responsible NASA safety official. They will make calls to obtain medical, fire, or emergency assistance, notify their immediate supervisor and the installation safety office, and provide other assistance as needed. The information passed to the safety office will outline the need for further assistance such as security for crowd control, special equipment needs, etc. For mishaps in the public domain, the nearest NASA installation will be notified and will initiate mishap notification and response procedures.
- b. **Installation Safety Office.** The installation safety office will be designated by the Center Director as the initial focal point for all mishaps on the installation, for mishaps in programs managed by the installation, or for NASA mishaps on the nearby public property. Upon notification of a mishap, the safety office will ensure that all other offices that should be notified of the circumstances are contacted. This will include notification to NASA Headquarters if the mishap is a Headquarters reportable mishap as defined in paragraph 2.2-9. During duty hours, the Safety Division will be the Headquarters notification point. During nonduty hours, the Duty Officer (FTS 755-3333 or commercial (202) 755-3333) will be the notification point. NASA Form 1367, "Telephonic Report for a NASA/NASA Contractor Mishap," will be used as a guide for providing information to Headquarters. The installation safety office will assure that the appropriate local officials are notified if the mishap may cause a danger to the local community.
- c. **Safety Division.** The Safety Division, as the Headquarters focal point for the initial reporting of all NASA mishaps, will be notified of the circumstances of all mishaps that are reportable to Headquarters. The Safety Division will notify or assure that all appropriate offices, as outlined on the Headquarters Mishap Notification List, are notified as soon as possible. This will include notification of the appropriate Program Office(s) and the appropriate Associate Administrator. A written followup will be provided within 1 working day using NASA Form 1367 as a guide. The Safety Division will also make the initial notification to appropriate government agencies, as necessary.
- d. **Headquarters Duty Officer.** The Headquarters Duty Officer will be notified of all NASA mishaps occurring during nonduty hours that are reportable to Headquarters. He/she will follow the procedures in the Headquarters Mishap Notification List for contacting the appropriate

management and program officials or their safety points-of-contact and the Director, Safety Division, or alternate.

- e. **Headquarters Safety Points-of-Contact.** Headquarters points-of-contact within each office will be responsible for relaying all mishap information to the appropriate officials in their office. They will be contacted by the Safety Division or by the NASA Duty Officer. They will also serve as the dissemination point for follow-on written updated reports provided by the Safety Division.
- f. **Program and Other Personnel.** When local or Headquarters Program Officials or other personnel are notified of reportable mishaps by any office or source other than safety personnel, they will immediately notify the cognizant safety office and pass on all facts of the mishap so that the safety office can commence with initial notification procedures.
- g. **Notification of OSHA.** The Safety Division will notify OSHA within 48 hours when a mishap involves a fatality or the hospitalization of five or more NASA and/or non-NASA employees. These will be Type A accidents. This does not relieve the contractor of the responsibility to notify OSHA if the mishap involves NASA contractor personnel.

2.5 MISHAP INVESTIGATIONS

1. GENERAL

- a. All NASA mishaps will be investigated. The severity of the mishap will determine the degree of investigation. Minor personnel incidents or minor equipment damage may only require a supervisory investigation. Major mishaps will require a Board of Investigation. Causes and effects as well as corrective measures shall be documented as an integral part of the accident prevention effort.
- b. A Board of Investigation will be appointed for all Type A mishaps, and those mission failures, test failures, and Type B or other mishaps that have sufficient programmatic, public, political or cost impact. This determination will be made by the Installation Director and the appropriate Headquarters personnel.
- c. The investigation of a mishap consists of a scrutiny of relevant data, a reconstruction of the circumstances, an analysis of possible causes, a determination of the actual cause or possible cause and contributing cause factors, and the preparation of a two-part report giving (1) findings and facts and (2) analyses, including conclusions drawn and recommendations for corrective action.

2. INVESTIGATION BOARD APPOINTMENTS

- a. Appointing officials shall appoint chairpersons and members of investigation boards who are third parties, not directly connected with the operation in which the mishap occurred. Members of the investigation board should have peer/technology affiliation with the mishap. For facility mishaps, facility specialists should be included as members of boards. When it is practical, and especially when major programs and/or high visibility activities are involved, appointing officials shall select some of the board members/chairperson from field installations other than where the mishap occurred. When appointed, the investigative duties of each board member shall take precedence over other duties. The appointing authority will assure that each board member is able to act impartially.

Funding for specialists from other installations will be provided by the program or installation responsible for the investigation. These funds will be provided from locally available sources, or provisions to obtain them through other installation or Headquarters sources will be made.

- b. Field Installation Directors. Field Installation Directors shall appoint a chairperson and members of investigation boards for those mishaps which involve only the functions and activities of their respective installations or where, by agreement with other Field Installation Directors and the appropriate Associate Administrator(s), they have been designated to take the lead in investigations. If there are fatalities, a Headquarters appointed Board of Investigation will be established by the appropriate Associate Administrator to take the place of an installation appointed Board of Investigation.
- c. Associate Administrators. The appropriate Associate Administrator, in conjunction with the Chief Engineer, shall appoint a chairperson and members of the investigation boards for fatalities or for program, test, or mission related mishaps that involve more than one installation or organization. The Associate Administrator having primary institutional responsibility for mishaps, which involve more than one center or organization and institutional equipment/facilities, will appoint the Board of Investigation. When facilities are involved, facility specialists shall be included as members of the Board of Investigation.
- d. The Chief Engineer. The Chief Engineer may participate at his/her discretion in the proceedings of all investigation boards as an ex-officio, nonvoting member. The Chief Engineer shall be the focal point for the appointment of NASA personnel to joint NASA/DOD boards.

3. INVESTIGATIONS BY THE ADMINISTRATOR

- a. Notwithstanding the above, the Administrator or the Deputy Administrator may decide to direct the conduct of the investigation or direct a review of an investigation conducted by others.
- b. Unless indicated otherwise, when the Administrator or Deputy Administrator initiates an investigation, the activities of other investigative boards or comparable groups shall cease. If other statutory or contract clauses require additional or parallel investigations, provisions shall be included to meet such requirements. To prevent change to the affected hardware, while allowing other investigations to be completed, the document appointing a chairperson or board shall also designate a specific time or milestone after which all activities physically affecting the hardware shall cease, unless directed otherwise by the board.
- c. The Administrator or Deputy Administrator will designate the official who will arrange the necessary documents for initiating and conducting the desired investigation or review. The designated official shall consult with the Assistant Administrator for Legislative Affairs, and the Associate Administrator for External Relations about the desirability and necessity for Congressional notification and press releases. For all mission failure review boards established by the Administrator or Deputy Administrator, the Chief Engineer serves as an ex-officio member.

4. INVESTIGATION BOARD COMPOSITION

- a. The size and composition of an investigation board will be tailored to the specific mishap involved. Competent executive, supervisory, and specialist personnel should be chosen for the board to cover management and technical areas involved. The board will consist of an odd number of members with the following minimum membership requirements (for fatalities see subparagraph b).
 - (1) The Board Chairperson must be a NASA official.
 - (2) At least five NASA officials are required for a NASA Type A accident investigation board.
 - (3) At least three NASA officials are required for a NASA Type B, mission or test failure accident investigation board, if a board is used.
 - (4) Supporting specialized or technical groups/committees will be chaired by NASA officials who are voting members of the board.
 - (5) Quality assurance/reliability officials may be used in voting or advisory capacity as appropriate.

- (6) A physician will be included as a member or an advisor if the accident involves death or critical injury or if human factors are substantively involved.
- (7) Local safety officials and personnel from the Office of the General Counsel will provide advice to the board, but they will not be members of the board.
- (8) Other NASA personnel may be designated as consultants or advisors to the board.
- (9) Contractor personnel and others may be consultants or advisors to the board, but they should not be included in board deliberations except as provided in subparagraph 8.
- (10) Personnel from other Government agencies (United States Air Force, Federal Aviation Administration, and others) may participate as members or advisors, if required, or as provided for joint agreements between those agencies and NASA.
- (11) NASA personnel may not serve on contractor investigation boards, but may participate as advisors or observers.
- (12) The Director, Public Affairs Division, shall designate a qualified Public Information official to assist the board in developing and coordinating news releases in accordance with NASA policies and with the advice of the Program/Field Installation Director, the Board Chairperson, Legal Counsel, and the NASA Director, Safety Division, for those mishaps that are being coordinated at the Headquarters level.

- b. If there are fatalities, a Headquarters Board of Investigation will be established by the appropriate Associate Administrator. NMI 8621.1 is being revised to provide guidance for board composition and special procedures.

5. INVESTIGATION OFFICERS FOR MISHAPS NOT REQUIRING A BOARD

NASA Installation Directors may appoint investigating officers for mishaps not requiring a Board. During an investigation, this officer will be relieved of other duties. He/she will be furnished clerical assistance, transportation, communications, and other facilities, as necessary, to conduct an efficient and prompt investigation. Whenever possible, the services of an experienced and/or trained investigator or safety official should be utilized. The need for and depth of the report will depend on the severity of the mishap. As a minimum, for all mishaps, the cognizant supervisory personnel should analyze the facts concerning the mishap and provide reports as requested.

6. CONDUCTING THE INVESTIGATION

- a. During rescue and disaster control efforts, the Installation Safety Official or others will serve as the temporary official-in-charge, and preserve evidence and determine the most logical method of proceeding, with analysis of the accident/incident. Upon arrival, the Investigating Board or Investigating Officer, assumes jurisdiction and the temporary official-in-charge will be available to brief and advise on the fact finding process and technical assistance available. Administrative, communication, and technical support should be provided by the host or nearest NASA installation. Normally the board proceedings will be conducted in closed session. The Chairperson of the Board may open the hearings to others if circumstances so warrant.

- b. The Chairperson is responsible for submission of preliminary and progress reports (see subparagraph 2.6-3) to the Headquarters focal point handling the review, coordination, and closeout of the report.
- c. The appearance of witnesses before an accident or incident investigation board will be governed by the following guidelines:

- (1) The Chairperson of the Board shall determine whether or not witnesses shall testify under oath. If witnesses do not testify under oath they will be permitted to read and comment on transcripts of their statements before the statements are made a matter of record.
- (2) In closed session, witnesses will be advised before they testify that the purpose of the investigation is not to determine liability or blame but to determine factors relating to the mishaps and that their statements, if released, will be released in accordance with NASA and Federal Freedom of Information policies.

7. REOPENING THE INVESTIGATION

Although the investigation may be over and closed, it may be reopened by the appointing authority or responsible Headquarters program office, if additional evidence indicates that the findings of the previous investigation were incomplete or incorrect.

8. CONTRACTOR SUPPLEMENTAL INVESTIGATIONS

- a. When a mishap occurs in a contractor operation, determination will be made by the NASA Field Installation Director or Contracting Officer if a contractor supplemental investigation is required, based on the following considerations:
 - (1) Provisions of the contract.

- (2) Whether the primary interest in the mishap is within NASA or with the contractor(s) involved.
 - (3) The financial liability of the contractor.
 - (4) Whether the principal cause will most likely rest with NASA or within the contractor's areas of responsibility.
- b. When NASA interest or NASA involvement is substantial, a NASA board should investigate. A contractor report may be provided to the NASA board as evidence, if required or appropriate. When contractor interests or involvement is primary and the NASA interest is limited, the contractor will be requested to provide a report of the contractor investigation. In such cases, the reviewing NASA authority may appoint and utilize a NASA review board.
 - c. In the absence of a contractual prohibition, the contractor has the prerogative to conduct his/her own investigation.

2.6 INVESTIGATION BOARD REPORTS

1. REQUIREMENT

A formal board report shall be submitted to NASA Headquarters for all Type A mishaps, and those mission failures, test failures, and Type B mishaps and other serious mishaps that have been determined to have sufficient Headquarters interest.

2. REPORT CONTENT

All mishap reports will have an executive summary, a factual section containing a narrative of the mishap, evidence, and photographs, and an analysis section containing the probable sequence of events based on the board's conclusion, and recommendations to prevent similar occurrences. Formal board reports will use NASA Form 1388, "Mishap Report Table of Contents," as a format for the report content. Minority opinions may be submitted as part of the report.

3. ADDITIONAL REPORTS

The following types of accident/incident reports, in addition to or in lieu of the formal Investigation Board reports discussed in the previous paragraph, shall be employed:

- a. Telephone. Immediate reports are made by telephone to the NASA Safety Division for all mishaps that are reportable to Headquarters (see Paragraph 2.2-9). These include all Type A, some Type B, mission failures, test failures, or those that may have a severe programmatic, public, or political impact. NASA Form 1367, "Telephonic Report for a NASA/NASA Contractor Mishap" (NASA Reports Control No. 10-000-00605) will be used as a guide.

- b. Preliminary. Preliminary reports are follow-on to telephone reports and are made by teletype (TWX) or facsimile transmission (FACS) to the Headquarters focal point and program or appropriate offices (see NASA Form 1367). TWX or FACS reports submitted in accordance with this procedure will be labeled "PRIORITY" in compliance with NMI 2530.2, "Assigning of Precedences to Record Messages," plus the legend added to the address line—(TOP PRIORITY HANDLING).
- c. Progress. Progress reports will be provided periodically as determined by the Board Chairperson or Installation Director, or as requested by Headquarters (see NASA Form 1367). The addressees should be the same as for preliminary reports.
- d. Contractor Investigation Reports. When NASA contractors are required to investigate or report on mishaps involving contractor personnel and activities, the contractor reports may become a part of or substantiating data for the NASA report when approved or accepted by a board or investigating official. The contractor reports are not, in themselves, NASA reports (see subparagraph 2.5-8).
- e. Informal Reports. Informal reports are submitted to the Field Installation Director covering mishaps of a nature not requiring boards, but investigated by an investigating officer. The format of a formal report should be used, but reduced as needed.
- f. Safe-Alert Reports. When a material deficiency is identified as a probable cause of a mishap, an alert report should be submitted in accordance with NMI 5310.1, "Alert-Reporting of NASA Parts, Materials, and Safety Problems." A copy will be included in the formal report.
- g. Mishaps that involve the loss or destruction of NASA property require the submission of a NASA Form 598 (see NHB 4200.1, "NASA Equipment Management Manual" for details).

4. SCHEDULE, REVIEW, AND CLOSEOUT PROCEDURES

- a. Appointing Official. Board reports shall be forwarded to the appointing official for review and approval within 60 days of the mishap unless additional time has been granted by the appointing official. The appointing official for the Board of Investigation will:
 - (1) Approve the report and assure followup and closeout on all recommendations.
 - (2) Forward 20 copies of the report to the Headquarters focal point that is responsible for coordinating the closeout procedures within 15 days after receiving the report. With the report will be provided the field installation's response to the report's recommendations including the assigned responsibility and schedule for close-out, a summary for Public Affairs, and a "Lessons Learned" summary (e.g., brief narrative, videotapes,

etc.) for distribution to NASA installations for information. One summary can meet the requirements for an executive, public affairs, or lessons learned summary.

- (3) Provide quarterly status reports to the Headquarters office coordinating the Headquarters review and closeout on all those items that remain open.
 - (4) Provide a statement in writing to the Headquarters office coordinating the Headquarters review and closeout, that all the items have been satisfactorily closed out and the followup is complete.
- b. **Headquarters Focal Point.** The Headquarters focal point for review, concurrence, and closeout of all mishaps will be the Director, Safety Division. After receiving the report, the Director, Safety Division, will:
- (1) Prepare a coordinated Headquarters list of items remaining in an open status, requiring quarterly reports until corrective action is completed and provide the results of the Headquarters review to the appointing authority and appropriate Headquarters offices.
 - (2) Prepare a coordinated Headquarters evaluation of the Board of Investigation Report and management actions taken.
 - (3) Certify that the investigation and followup have been completed when no further actions are deemed necessary and coordinate the final closeout with the appropriate Associate Administrator.
 - (4) Prepare appropriate notification to elements within and outside of NASA of facts arising from the investigation.
 - (5) Maintain a completed file on the report for NASA use. The completed file will consist of the basic formal board report, forwarding correspondence, the Headquarters evaluation, and a record of followup action.

2.7 RELEASE AND DISSEMINATION OF NASA MISHAP INFORMATION

1. GENERAL

Release of mishap information and mishap investigation reports is the responsibility of the Associate Administrator for External Relations through the Director, Public Affairs Division, and through Field Installation Directors by their public information officers. Because mishap information requires special precautions (in addition to any security precautions), Board Reports submitted under this issuance should have the following notation on the first page or cover of the report:

"NOTICE: This document may be exempt from public disclosure under the Freedom of Information Act. Requests for its release to persons outside the U.S. Government should be handled under the provision of NMI 1382.2, 'Availability of Agency Records to Members of the Public.'"

Requests for mishap information will be referred to NASA Headquarters Public Affairs Division (Code LF) who will coordinate, as appropriate, with the Legal and Safety staffs as well as other offices concerned.

2. DISSEMINATION OF "LESSONS LEARNED" PACKAGE

The appointing official or the Headquarters office coordinating the review and closeout procedures may provide a summary of the Board of Investigation Report, the corrective actions taken, and any other relevant data as a "Lessons Learned" package to all Field Installation Directors.

3. RELEASE TO THE NEWS MEDIA AND PUBLIC

NMI 1382.3, "Release of Accident Investigation Reports to the Public," and NMI 1382.4, "Release of News Media of Information Concerning Accidents and Casualties," contain guidance on releasing mishap information to the news media and the public. The Public Affairs Division, Code LF, will coordinate the release of mishap information to these sources.

4. CONGRESSIONAL REQUESTS

Requests submitted by the Congress, its committees, or members shall be referred to NASA Headquarters, Office of Legislative Affairs (Code C), Washington, DC 20546, in accordance with NMI 1450.4, "Handling Congressional Correspondence and Information Concerning Congressional Activities."

5. CONTRACTOR REQUESTS

Access to the formal report will be governed by the provisions of NMI 1382.2. The manufacturer may be furnished summaries or extracts of factual technical information (e.g., records, reports, photographs, and like items) which relate to the design, performance, or manufacture of material.

6. OTHER ORGANIZATION'S REQUESTS

Specific agreements with other agencies and contractors will be followed. However, for mishaps where it is not practical to withhold information until the appropriate provisions can be met, procedures for public announcements will be the same as for NASA. Every reasonable effort will be made to inform the cognizant organization of NASA's intent to release the information. The Associate Administrator for External Relations will release the data.

**7. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION (OSHA) REQUESTS**

OSHA may desire information on mishaps. All requests from OSHA should be referred to the Associate Administrator for External Relations, who will coordinate with the Office of the General Counsel and the NASA Director, Safety Division.

**8. EXCLUSIVE EMPLOYEE REPRESENTATIVES AND SAFETY AND
HEALTH COMMITTEES**

A copy of mishap investigation reports that involve injury or illness to personnel will also be forwarded to appropriate safety and/or health committees and local exclusive employee representatives, if any, as stated in 29 CFR Part 1960.

**2.8 PERSONNEL INJURIES AND PROPERTY DAMAGE RECORDKEEPING AND
ANALYSIS**

1. GENERAL REQUIREMENTS

Injuries, occupational illnesses, and incidents shall be reported to the office designated to record and report these events at the installation in compliance with the Occupational Safety and Health Act, Executive Order 12196, 29 CFR Part 1960, Subpart I, and 29 CFR Part 1910. For each occupational illness or injury, the data discussed below shall be maintained and submitted on reports as indicated.

a. Initial Record

- (1) There is no designated form to be used and each installation may utilize its own data collection method. Employees are responsible for initiating action necessary to report occupational injuries or illnesses. As an option, the NASA Form 1392, "Industrial Mishap Report" (RCS-10-000-00605), may be used. When the injury or illness is related to a motor vehicle accident, Standard Form (SF) 91, "Operator's Report of Motor Vehicle Accident," and/or SF 91A, "Investigation Report of Motor Vehicle Accident," may be used.
 - (2) As a minimum, initial reports shall be filed with the installation's safety office and health unit.
- b. Installation Log. The OSHA Form 100F (Rev. January 1976), "Log of Federal Occupational Injuries and Illnesses" (RCS-10-0000-00609), shall be maintained at each installation. The office maintaining this data will make such data available to Installation Safety, Health, or Compensation Claims Officers as required.
- c. Quarterly and Annual Report. The OSHA Form 102F, "Summary Report of Federal Occupational Injuries and Illnesses" (RCS-10-0000-00609), and a summary report of property damage mishaps will be

submitted by each installation to the Safety Division within 30 days following the end of the reporting quarter. For annual reports, the Form 102F and property damage report will be submitted 30 days following the end of the calendar year. Injury cases being controverted will be reported, but noted to distinguish them from noncontroverted cases. The annual report will be used to correct any previous quarterly reports changed due to conversion, extended injuries, or Office of Workers' Compensation Programs (OWCP) rulings. Service/support contractor experience reports will be submitted on the same schedule.

- d. Fatality and/or Multiple Injury Reports. In the event of any fatality or mishap on NASA property involving five or more individuals, NASA or non-NASA, as the result of an occupational injury or illness or an accident involving visitors, the Safety Division will be notified immediately.
- e. Mechanical Power Press Injuries Reports. Each field installation will report the circumstances of mechanical power press injuries to OSHA, Director of the Office of Standards Development, Washington, DC 20210 within 30 days of the occurrence. The criteria, format, and information requested is contained in 29 CFR 1910.217(g). Copies of all reports submitted will be provided to the Safety Division.
- f. Periodic Experience Reports. The installation safety official will assure that periodic experience reports are forwarded to the Director, Safety Division, for both NASA and on-site service/support contractors in the format and manner described herein for the following reports:

- (1) Summaries (Annual). Brief summaries of Type A and Type B accidents and significant incidents (including appropriate near-misses) will include facts, conclusions, recommendations, and corrective actions; and where fires are involved, the cost factors to show book value and estimated replacement costs. (Negative reports are required.) These summaries should be in a format compatible with the Annual NASA Mishap and Injury Data Report (RCS 10-0000-00213).

- (2) NASA Form 345, "Accident Cause Analysis Report." NASA Form 345, "Accident Cause Analysis Report (RCS-10-000-00214), will be completed for each calendar quarter and year and forwarded with the OSHA 102F reports to the Director, Safety Division.

2. DETERMINATIONS FOR RECORDING INJURIES/ILLNESSES

- a. General. DOL has provided guidance for recordability of specific types of injuries and illnesses. This guidance is contained in OSHA Publication 2014 (Rev. Jan. 1978), "Recordkeeping and Reporting Guidelines for Federal Agencies," and in the Bureau of Labor

b. Specific Problem Cases

- (1) Occupational illnesses and some injuries are often difficult to judge as to their job-related cause. In these circumstances they shall be recorded on the installation's OSHA Form 100F when they are diagnosed or when a claim is filed. However, these illnesses or injuries should not be utilized for rate or severity computations until the quarter when the claim is approved by the Office of Workers' Compensation Programs (OWCP/DOL). Pending or controversial cases shall continue to be reported as an addendum to the installation's quarterly OSHA Form 102F report.
- (2) After the injury or illness has initially been recorded in Columns 9 and 9a of the log (Form 100F), subsequent days of restricted duty or partial lost workdays due to the injury/illness, will be recorded only in Column 9b of the log. Partial days for which employees were at work but took time off for related medical reasons may be recorded as fractions of an 8 hour day. These additional days of restricted duty or partial time will be added to the initial days lost as a result of the injury or illness to determine severity.
- (3) When an employee is permanently disabled from a work-related injury or illness, the counting of lost workdays for OSHA-recording purposes should stop the day it is decided that the employee was permanently disabled. For example, the date to be used is the date of the report from the attending physician that the employee is to be considered permanently disabled for compensation purposes. Although it is required by the Office of Personnel Management (OPM) to keep such an employee in a Leave Without Pay (LWOP) status for 1 year after the injury to facilitate a return to duty should the employee recover, one does not need to count this full year as lost workdays on the OSHA log. In addition to the number of lost workdays, such a case will also be recorded as a "termination" in column 11 of the OSHA log.
- (4) While OSHA lost workday cases and OWCP compensable cases should normally correlate, two exceptions exist, which are:
 - (a) A case which does result in a light duty assignment type of restricted duty but does not result in Continuation of Pay (COP) or outside medical expenses which would be OSHA recordable, but not OWCP compensable, and it will probably be a lost time case.
 - (b) A case with outside medical expenses for first aid care or a diagnostic workup which concludes that no injury or

illness exists (e.g., negative x-ray) would be OWCP compensable, but not OSHA recordable.

- (5) Where guidelines are unclear as to the recordability or reportability of an occupational injury or illness case, the Director, Safety Division, in conjunction with the representatives of the Occupational Health Office, will issue a determination.

3. INVESTIGATION OF OCCUPATIONAL INJURIES/ILLNESSES

A thorough investigation of the work related circumstances involved in each lost time occupational injury or illness shall be made by the installation's safety personnel or by the installation's health personnel, as appropriate. This does not prevent supervisory personnel from conducting their own investigation. Such techniques as on-site inspections, reenactment of the circumstances, and personal interviews will be utilized to gather information and to assist in the formulation of corrective action. Reports from the safety/health staffs shall be promptly transmitted to the installation's Compensation Claims Officer to assist in making claims determinations. If the investigation indicates the possibility of a fraudulent claim, the Compensation Claims Officer will refer the case to the Office of Inspector General for investigation and initiate controversy procedures.

4. ANALYSIS

a. General. All occupational injuries will be analyzed to determine the sequence of events and the necessary corrective action. The analysis shall be in accordance with the American National Standard Institute's (ANSI) Method of Recording Basic Facts Relating to the Nature and Occurrences of Work Injuries, ANSI Z16.1(R1969). Minor first aid type of injuries should be analyzed to determine any unfavorable trends or underlining factors.

b. Injury/Illness Trends. Gross trend data for injuries and illnesses may be kept on a quarter-by-quarter or more frequent basis by the installations through the use of frequency (both total and lost time) and severity rates, the formulae for which are:

$$\text{Frequency} = \frac{\text{No. of injuries/illnesses} * 200,000 \text{ hours}}{\text{Total number of hours worked}}$$

$$\text{Severity} = \frac{\text{No. of days lost} * 200,000 \text{ hours}}{\text{Total number of hours worked}}$$

* See paragraph 2.8-2b.

CHAPTER 3: SAFETY AND HEALTH REQUIREMENTS FOR NASA CONTRACTS AND CONTRACTOR OPERATIONS

3.1 GENERAL

This Chapter describes the general approach for safety and health programs and activities of NASA contractor operations. The Chapter is not a direct instruction to contractors, but provides guidance for NASA officials with responsibility for assuring safety and health under NASA contracts.

3.2 OBJECTIVES

For NASA to assure adequate safety and health programs, contract safety and health requirements must be appropriate and effective. To accomplish this, it is expected that:

1. Contractors/subcontractors will (as applicable) design, produce, or develop products or equipment or manage facilities such that they can be operated and/or inhabited in compliance with NASA and OSHA standards without modifications or restrictive procedures.
2. Contractors/subcontractors shall be held responsible and responsive in matters of safety and health. The contractor's compliance with NASA safety and health standards will be contractually binding and should be a factor in the award determinations. Compliance with OSHA safety and health standards will be as prescribed by law.
3. Contractors/subcontractors shall be required to provide the contracting officer or other representative information on any of their operations that could be a risk or present a hazard to nearby NASA operations. This also includes providing information on hazardous material to be used. The contracting officer may request copies of material safety data sheets for new hazardous materials.
4. Contractors/subcontractors shall be required to develop appropriate safety and health plans that include assignment of responsibilities for safety and health at the work site.
5. Contractors/subcontractors shall properly reflect the "flow-down" of safety and health responsibilities between appropriate tiers.
6. Contractors/subcontractors will develop motivation and awareness programs for their employees in safety and health matters. This will include regularly scheduled safety and/or health meetings for supervisors, foremen, and employees.
7. Contractors/subcontractors will properly communicate safety and health data on mishaps/near misses and like items to NASA.
8. Contractor/subcontractors activities are properly monitored and evaluated for compliance with the safety and health provisions or requirements of the contracts. These evaluations will be conducted in a

timely manner to note and correct any safety and health problems at an early stage.

9. Access to contractor activities, for purposes of determining the adequacy of safety or health measures, will be provided to contracting officer representatives or their designees.
10. Provisions for suspending work will be established in cases where safety or health considerations warrant such action, and will be included in the contract.
11. On-site contractors will be adequately responsive to field installation health, safety, and emergency planning requirements and clear points-of-contact as well as responsibilities on safety and health matters will be established in contractor operations.
12. Job hazard analyses will be developed and provided to NASA for approval prior to any major phases of work as directed by the contracting officer.

3.3 CONTRACTOR RELATIONSHIPS WITH OSHA

1. RESPONSIBILITY

NASA contractors are not relieved of their responsibility to comply with all applicable Federal and state OSHA requirements. NASA authorities will contract on the basis that contractors are complying with OSHA standards and Public Law 91-596. Contractors will assess all Government Furnished Property (GFP) or Facilities (GFF) associated with the contract and indicate areas of noncompliance with OSHA standards to the contracting officer who will then direct corrective action.

2. ACCESS GRANTED TO STATE OR FEDERAL COMPLIANCE OFFICERS

Federal (OSHA) or state Safety and Health Compliance Officers will be allowed on NASA installations to review and survey contractor operations. If the state does not have a DOL approved Safety and Health Plan or the installation is under exclusive federal jurisdiction, only federal compliance officers have the right of access to contractor operations.

3. CONTRACTOR CITATIONS

Under Public Law 91-596 the employer is responsible for providing employees with safe and healthful working conditions regardless of where the employees are working. Thus, the contractor must make a timely reply to any OSHA citation received, even though issued with reference to working conditions in a Government Furnished Property. The contractor is responsible to settle citations issued against the operation unless covered by subparagraph 4.

4. CONTRACTOR CITATIONS INVOLVING GOVERNMENT FURNISHED PROPERTY (GFP) OR FACILITIES (GFF)

If a contractor is cited for exposing their own employees to hazardous conditions involving GFP or GFF, the contractor, as the immediate employer, is responsible to respond to the citation. However, because of the shared responsibilities (the GFP or GFF belongs to NASA but the contractor assessed the safety of the GFP or GFF), the contractor and NASA will enter into negotiations to determine their respective liabilities. To continue the contractor operations, the contracting officer has the following options:

- a. Recommend that the contractor request a variance from the pertinent standard from DOL or the state when alternate safety or health measures will provide adequate protection.
- b. Negotiate for a replacement of the unsafe GFP or GFF with contractor-owned property.
- c. Replace with other suitable GFP or GFF.
- d. Authorize modification of GFP or GFF at contractor expense with the understanding that title to any nonseverable modification vests in the Government. (This will probably be an option for small modifications only.)
- e. Authorize modification of the GFP or GFF by the contractor at government expense. Necessary funding approvals will be required pursuant to NASA regulations.

3.4 CONTRACTOR MISHAP REPORTING INVESTIGATION AND RECORDKEEPING REQUIREMENTS

1. All contractor mishaps will be reported and recorded in accordance with requirements in the OSHA regulations and as stated in the contract.
2. Investigations of contractor mishaps will be performed in a manner determined by the contracting officer and in compliance with NASA investigation procedures. The proposed corrective action will be evaluated for adequacy by the installation safety or health officer, as appropriate. The contracting officer or designee will verify that the corrective procedures are being followed during normal contract monitoring.
3. Contractor mishaps that are judged to be of significance by local safety officials will be reported to the NASA Director, Safety Division.
4. Service/support contractors will keep records of lost time frequency rate, lost time injuries, exposure, and property damage and furnish this to the contracting officer on a quarterly and annual basis in sufficient time to allow the contracting office to forward the data to meet Headquarters suspense dates.

5. See Chapter 2 of this handbook for further guidance.

3.5 MISHAP INVESTIGATIONS BY STATE AND FEDERAL OSHA AGENCIES

Federal and state (unless exclusive Federal jurisdiction is claimed for the mishap) OSHA investigators will be allowed to investigate a contractor mishap occurring on a NASA installation. The NASA Director, Safety Division, will be notified of OSHA's (Federal or state) desire to investigate and/or the results of their investigation.

3.6 NASA PROCUREMENT REGULATION (PR)

The NASA requirements for inserting general safety and health provisions in contracts appear in the NASA Procurement Regulation Part 1, subpart 52. Likewise, NASA PR Part 14, subpart 6 outlines system safety requirements. Certain requirements, in particular contracts, will be mandatory and will appear as a general provisions clause. Additional specific requirements will be tailored to the procurement action and shall be set forth in the schedule of the contract to assure adequacy and appropriateness in such matters as: (1) health, (2) system safety, (3) aviation safety, (4) fire safety in NASA-owned facilities, (5) hazardous material handling, and (6) the references to specific safety and health standards with which compliance will be required.

3.7 CONTRACTOR SAFETY AND HEALTH PLANS

1. Contractor safety and health plans are written plans prepared by the contractor summarizing both the overall safety program and health program, respectively, that will cover the employees and equipment used to fulfill the contract. The degree of detail will depend on the scope of the contract. Plans will address all aspects of the contract: manufacturing, construction, transportation, testing, etc. It is not intended that the contractor's normal industrial home-plant safety and health rules and directives be subject to NASA approval, but it is intended to ensure that the contractor has adequate safety and health programs and has not neglected safety and health in the interest of obtaining a more favorable bid in the short term.
2. Contractors will be required to submit both safety and health plans to the contracting officer and obtain government approval prior to start up of operations unless the contracting officer specifically exempts them from the requirements in accordance with criteria in NASA PR Part 1, subpart 52. The requirement will be stated in the contract. The plans will be reviewed for safety by the cognizant safety official and for health by the cognizant health official. For construction contracts, changes to the safety plan may be made at the prework briefings, provided the changes are signed by both the contractor and contracting officer. This will be reflected in the minutes. "Rough" safety and health plans can also be reviewed and used to assist in contractor selection during source evaluation procedures (see paragraph 3.9).

3.8 CONTRACTOR PREWORK BRIEFINGS

Contractors will be briefed on safety and health requirements by the contracting officer or designee prior to their beginning work and on procedures to follow in event of a mishap. They will also be briefed on the adjacent NASA and other contractor operations that could pose a hazard to their operation and employees. Standard briefing checklists developed by the safety or health office may be used. Minutes and an attendance record shall be kept.

3.9 SAFETY DOCUMENTATION, HEALTH DOCUMENTATION, AND INPUT AT SOURCE EVALUATION BOARDS (SEB)

Concurrent with the request for proposal, the contracting officer should require each bidder or proposer to submit pertinent safety documentation, health documentation, and contractor safety plans, health plans, and copies of prior years OSHA Form 200. These documents will be provided to the cognizant safety officer or health officer, as appropriate, who will review them and provide input to the source selection official on the contractor's ability to undertake the contract with respect to safety and health requirements. The degree to which this requirement is levied will be determined by the contracting officer in conjunction with safety and health officials based on the degree of risk associated with the work of the contract and the overall cost. Lists of deficiencies in construction contractors past performance provided by the safety and health officials should also be used in determining source selection. This would be feasible only for those contractors that have had previous work experience at the installation. This will not be used to provide an unfair advantage to those contractors without previous experience.

3.10 RESPONSIBILITIES

1. PROGRAM/PROJECT OFFICIALS

Program/project officials are responsible for:

- a. Coordinating with the cognizant safety and health officials in determining and approving the respective safety and health requirements and objectives under which contract performance will take place, including specifications, standards, and specific tasks;
- b. Assuring performance of the required checks and inspections of contractor compliance with the safety and health requirements of the contract to the degree that such responsibility is delegated to a Contracting Officer's Representative (COR) by the contracting officer; and
- c. Assuring that scheduled and unscheduled surveillance of contractor safety and health matters is adequate to the nature of the procurement.

2. CONTRACTING OFFICERS

a. Contracting Officers are responsible for:

- (1) Assuring that all documentation such as Requests for Proposal/Invitations for Bids, Statements of Work, and proposed changes are reviewed from a safety and health standpoint consistent with the scope of the contract and that the safety and health requirements established by the cognizant safety and health officials, in conjunction with program safety and health officials, are incorporated into the contract;
 - (2) Negotiating safety and health provisions of contracts in accordance with pertinent procurement regulations and policies;
 - (3) Ensuring that contracts are not executed until appropriate management, health and safety officials have furnished specifications, standards, and specific contractor safety and health tasks which are to be performed;
 - (4) Using the expert advice of appropriate safety or health officials in source evaluations, award boards, contract negotiations, and contractor safety and health program evaluations and inspections;
 - (5) Upon advice or notification of the technically supporting appropriate safety or health official, resolving differences with contractors with respect to safety or health matters; and
 - (6) Coordinating all matters that affect safety or health with the installation safety or health official respectively.
- b. Hazards coming to the attention of the contracting officer will be reported to program and appropriate safety or health officials in a timely way.
 - c. Contracting officers will insert provisions in the contract to obtain copies of the contractors safety and health plans, and to require their approval prior to work commencing, unless waived in accordance with NASA PR Part 1, subpart 52.
 - d. Contracting officers will insert provisions in the contract of service/support contractors to obtain mishap data on a quarterly and annual summary basis (see paragraph 3.4).
 - e. Contracting officers will insert provisions in the contract to assure that contractor mishaps are properly investigated, copies of mishap reports and contractor board of investigation reports are provided to NASA and corrective actions are taken to prevent recurrence for those mishaps that occur during NASA contract operations.

3. HEALTH AND SAFETY OFFICIALS

- a. The NASA Procurement Regulation outlines the role of the installation safety and health officials in support of procurement activities (see NASA PR Part 1, subpart 52 and Part 14, subpart 6). In implementing those requirements, it will be useful to have locally developed material such as checksheets for use by the cognizant safety and health officials in providing the contracting officer with the assistance he/she will require in obtaining complete safety and health coverage in applicable procurement documents.
- b. As a minimum, safety and health officials will provide support to the contracting officer by:
 - (1) Reviewing and providing safety and health input, respectively, to documents associated with the various procurement phases.
 - (2) Serving as a technical advisor on safety matters and health matters, respectively, for Source Evaluation Boards (SEB).
 - (3) Reviewing, approving, or disapproving contractor safety and health plans.
 - (4) Conducting a technical evaluation or surveillance of the contractor's operation or product for compliance with safety and health provisions of the contract and providing this information to contracting officer, fee award boards, or final acceptance boards.
 - (5) Reviewing reports of completion for construction contractors and developing a list of deficiencies to be used at an SEB to evaluate the bidders.
 - (6) Investigating, as requested, contractor mishaps, advising contractor appointed investigation boards, and evaluating the adequacy of followup preventative measures.
 - (7) Reporting contractor mishaps or test failures that are significant to the NASA Director, Safety Division, in accordance with Chapter 2.
 - (8) Providing service/support contractor mishap experience and rates to the NASA Director, Safety Division, on a quarterly and annual basis.
 - (9) Determining the need for a contractor developed job hazard analysis.

4. ASSISTANT ADMINISTRATOR FOR PROCUREMENT

The Assistant Administrator for Procurement will:

- a. Publish the appropriate standard safety clause in the NASA Procurement Regulation (PR) and the policy circumstances under which general and schedule clauses are to be incorporated in contracts.
- b. Consult with and obtain the concurrence of the NASA Director, Safety Division, concerning safety clauses and with the Chief, NASA Occupational Health Office, concerning health clauses for deviations requiring the approval of the Assistant Administrator for Procurement in accordance with NASA PR 1.109.
- c. Consult with the Director, Industrial Relations Office, on safety and health provisions that appear to have an effect on industrial relations.

3.11 REVIEWS OF CONTRACTORS SAFETY AND HEALTH PROGRAMS

Field installations are expected to have appropriate, adequate, and effective contractor safety and health surveillance and evaluation programs. In those instances where the general safety and health clause is prescribed as set forth in the NASA Procurement Regulation, the contractor's safety and health programs, including actual performance and accident experience, will be evaluated during the initial stages of contract work to assure early correction of deficiencies and, subsequently, at least annually throughout the life of the contract. The depth of the evaluations and the techniques employed should fit the extent of hazards and the importance of the program. Selected announced, or unannounced, reviews of contractor operations may be conducted by NASA Headquarters and field installation safety program review teams and the NASA Headquarters and field installation health program review teams, respectively.

3.12 CONTRACTING OFFICER REPRESENTATIVES

1. DELEGATION

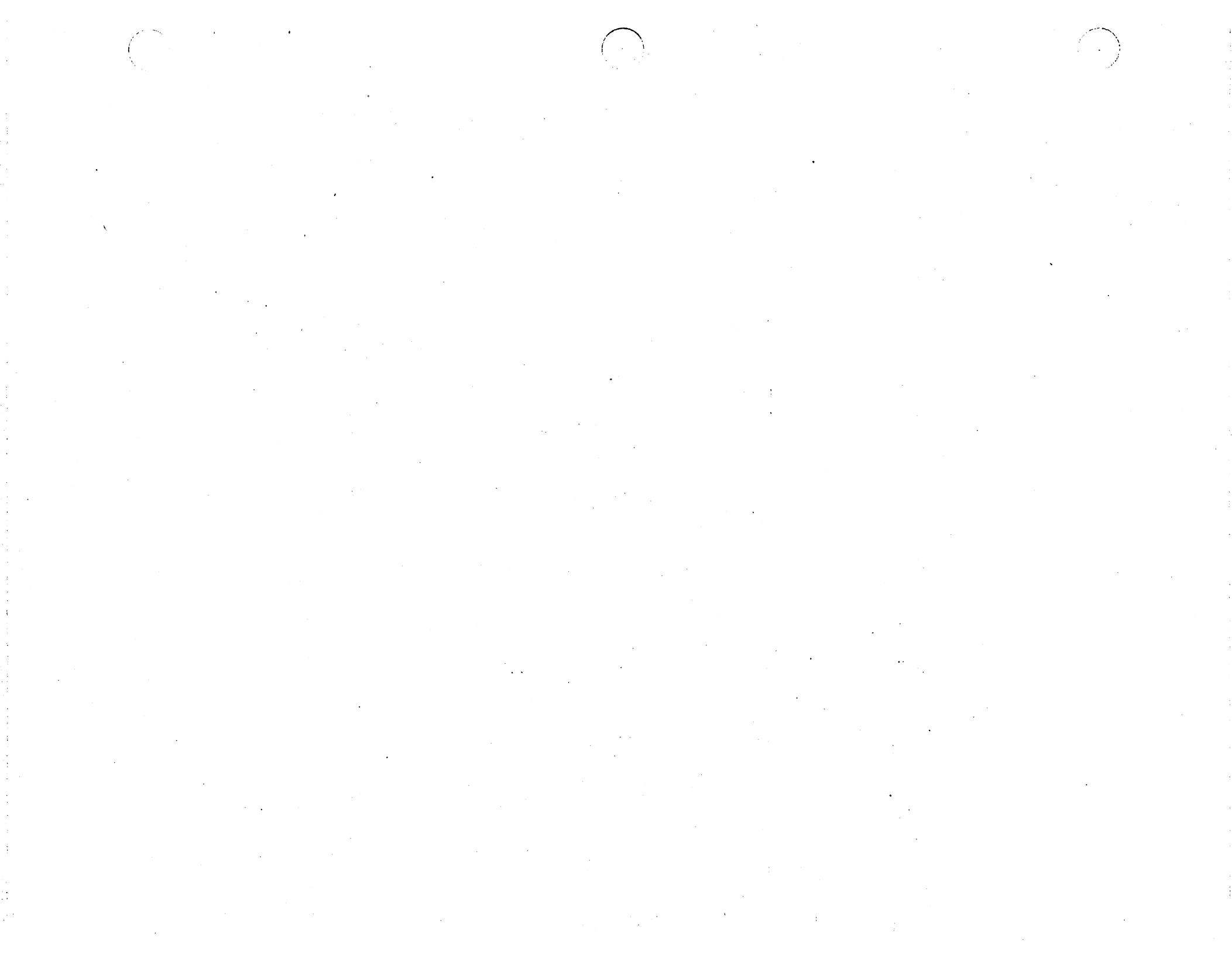
Appropriate delegation of authority will be made by the contracting officer to assure the safety and health provisions of the contract are adequate and being followed.

2. CONTRACT ADMINISTRATION SERVICES

Full consideration will be given by the contracting officer or designee to the effective utilization of contract administration services in personnel safety and health monitoring or evaluation of contractor operations (see NASA PR Part 20, Subpart 6).

3.13 GRANTS

The safety and health clauses in research grants is an integral part of the grant document.



CHAPTER 4: SAFETY AND HEALTH TRAINING

4.1 OCCUPATIONAL SAFETY AND HEALTH TRAINING POLICY

1. GENERAL

- a. It is Agency policy that top management is responsible for the safety and health of employees and the safe operation of facilities and equipment. It is also Agency policy that each manager and supervisor will have safety and health responsibility incorporated into his/her annual work performance plan. The sum total of these plans shall reveal an integrated management system/strategy of continuing review of and attention to safe and healthful working conditions, environments, procedures, rules, operations, and training. This ongoing management process shall be the core of the Agency's safety and health programs and shall provide the basis for the development and operation of a number of other functional plans such as those managed by safety, occupational health, or training personnel.
- b. Employees also have a direct responsibility in the proper functioning of the safety and health programs. This involves safe work habits, proper use of protective clothing and equipment, timely mishap reporting, etc.
- c. To assist management/supervisors and employees in their specific role and responsibilities in the Safety and Health Programs, training must be provided. Also Executive Order (EO) 12196 and Subpart H of the "Basic Program Elements for Federal Employee Occupational Safety and Health Programs," (29 CFR 1960.59), require that NASA establish comprehensive safety and health training programs.

2. SPECIFIC

The training program will be structured to ensure, as a minimum, that the following information is provided to all employees in paragraph 4.3 and as applicable.

- a. Essential features of the Occupational Safety and Health Act.
- b. Essential features of Executive Order 12196.
- c. The requirements of 29 CFR Part 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs."
- d. NASA's and the Center's Occupational Safety and Health Programs and pertinent publications and directives.
- e. Individual employee rights and responsibilities.
- f. Specific job-related safety and health information such as:

- (1) Hazards of the job.
- (2) Safe work practices.
- (3) Hazards of the work environment.
- (4) Use and care of personal protective equipment.
- (5) First aid procedures.
- (6) Reporting of injuries, illnesses, and hazardous conditions.

4.2 METHODOLOGY

1. Safety and health training of NASA employees in general is best approached by segmenting the instruction into that which would be appropriate for every individual (ideally presented at the time of initial orientation or in special lectures, seminars, etc.) followed by personalized instruction dealing with issues most relevant to the employee's work environment and task. To remain effective, however, this training must be reinforced at appropriate times by additional instruction and formal training as needed. The installation safety and health offices and the installation training office will provide guidance in this matter.
2. The role of the immediate supervisor in instructing the employee on the peculiar safety and health aspects of the job cannot be overlooked. This should take place prior to or on the first workday. The information in paragraph 4.1-2a through 4.1-2e can also be presented at this time or reviewed again. This has the added benefit of making the employee aware of the supervisor's interest in his/her safety and health and in the field installation's safety and health programs. However, formalized training should also be provided on a periodic basis.
3. For employees who will be engaged in specifically listed occupations that require personnel certification or licensing, formalized classroom training and evaluation may be required. See Chapter 6 for further information on these occupations.

4.3 TARGET GROUPS

Appropriate instruction and job-related safety and health training are required for all employees, with particular emphasis on:

1. Top management officials.
2. Supervisors.
3. Safety and/or health professionals.
4. Firefighters and emergency medical technicians.

5. Collateral duty safety and health personnel and committee members.
6. Employee representatives.

4.4 TARGET GROUP TRAINING NEEDS

1. TOP MANAGEMENT

These individuals shall receive instruction that will enable them to manage the Occupational Safety and Health Programs of their organizations. This should include financial management information, program requirements, results of outside and internal program evaluations, and a brief overview of the severity and complexity of hazards encountered in their operations.

2. SUPERVISORS

Supervisors must be trained to recognize and report safety and health hazards in their work environments and to identify and strive to eliminate unhealthful and unsafe work methods of their employees. Instruction should help develop requisite skills in implementing NASA's Safety and Health Programs within their work units, including the training and motivation of their employees toward safe and healthful work practices and their specific responsibilities in the programs.

3. SAFETY AND HEALTH PROFESSIONALS

A high level of competence is required of NASA's safety and health professionals to implement effective safety and health programs. This requires a continuous and comprehensive training and developmental effort. The mechanism for realizing this goal will be the individual's career development plan as outlined in paragraph 4.5-2. The emphasis will be toward providing each professional with knowledge of unsafe or unhealthful materials, processes, equipment, and procedures and recognized means to eliminate or mitigate the hazards associated with them. This will enable the professional to perform necessary technical monitoring, consulting, testing, inspecting, designing, and other tasks to ensure that the requirements of the NASA safety and health programs are being met in the workplace.

4. FIREFIGHTERS AND EMERGENCY MEDICAL TECHNICIANS (EMT)

Training for both NASA firefighters and EMTs is intended to be a combination of on-the-job training, schools, and special courses. Special courses may include participation in extension training programs, short courses, workshops, conferences, correspondence courses, or recognized professional schools. On-the-job training includes both the day-to-day attainment of knowledge through supervisor-subordinate contact in the performance of the job and in the accomplishment of regular training activities directed by NASA policy. The training shall be updated to include advances in equipment, products, and techniques. Certification, if required by the state or other licensing jurisdiction, will also be addressed.

**5. COLLATERAL DUTY SAFETY AND HEALTH PERSONNEL AND
SAFETY AND/OR HEALTH COMMITTEE MEMBERS**

Upon appointment of an employee to a collateral duty safety/health position or to a committee, appropriate training commensurate with the scope of their assigned responsibilities will be provided. Such training must include the recognition of unsafe or unhealthful conditions, reporting procedures, hazard abatement methods, and other information that will assist them in conducting workplace inspections and monitoring the safety and health programs' effectiveness.

6. EMPLOYEE REPRESENTATIVES

Training for NASA personnel who are representatives of employee groups, such as recognized bargaining units, will include information and materials that will enable such groups to ensure safe and healthful working conditions and practices in the workplace. In particular this instruction should enable them to effectively assist in conducting workplace safety and health inspections and monitoring the safety and health programs' effectiveness.

7. WORKFORCE EMPLOYEES

Training for workforce employees should include the general information on the NASA Safety and Health Programs, the Center Safety and Health Programs, as well as their roles, rights, and specific training relating to hazards in their peculiar workplace. It is the responsibility of individual health offices, safety offices, and supervisors to recognize potential hazards and arrange for the special training.

4.5 PLANNING AND IMPLEMENTATION

1. TRAINING PROGRAM PLAN

A comprehensive training plan(s) covering at least 2 years will be formulated by the field installation safety and health organizations with assistance from the installation training office. Costs for accomplishing this plan shall be included in the budget submittals so funds will be available to accomplish the planned training. The following facets should be considered in developing the training plan for all employees.

- a. Management commitment to establish and implement comprehensive training programs. Ideally, this should be in the form of a policy statement issued by senior management.
- b. Recognition of OSHA, NASA, National Fire Protection Association, Federal Aviation Administration, and other training requirements.
- c. Identification of employee target groups within the field installation population and determination of present training levels.

- d. Identification of specific tasks, hazardous conditions, or specialized processes and equipment encountered by employees which would require safety and health training emphasis.
- e. Identification and documentation of the planned training to be given to each employee category and the intended approach (course, literature, etc.). Refer to Appendix B for a suggested sample of a training schedule and career development plan.
- f. Determination of the availability of safety and health training resources. A lack of a specific training resource will require the development of a specialized training course or materials.
- g. Establishment of a training schedule (see Appendix A).
- h. Review, evaluation, and revision, if necessary.

2. SAFETY/HEALTH PROFESSIONAL CAREER DEVELOPMENT PROGRAM

- a. The continued technical proficiency and competence of NASA's safety and health staffs requires continuous, comprehensive training and personal development programs. A career development program formalizes that approach and serves as a goal setting mechanism, a planning tool, and a basis for an evaluation criteria. The program is a dynamic process that consists of a training schedule coupled with individualized analyses of training needs as they relate to the experience and expertise of the field installation safety and health personnel as a whole. Each safety and health professional should have a career development training plan.
- b. Prior to formulating a proposed training schedule, the following should be considered:
 - (1) Current level of expertise.
 - (2) Current and future duties.
 - (3) Overall responsibilities of the safety and health organizations as they relate to implementing the health and safety programs.
 - (4) Potential benefits of cross training.
 - (5) Unique operations or equipment in the field installation that may pose special hazards.
 - (6) Special interests and career goals.
 - (7) Availability of funds.
 - (8) Availability of courses, schools, etc., which provide the desired instruction.

- c. Subject to the above constraints, a training schedule is then developed (see Appendix B, "Safety and Health Career Development Plan," for an example of a possible format). Since the degree of success in implementing this program is to be used as a program evaluation criteria, the timing of the schedule should be a realistic reflection of training requirements and the capabilities to accomplish them.

3. RESPONSIBILITIES

It will be the responsibility of the field installation safety official and the occupational health official, with assistance, as needed, from the field installation training and personnel development offices and line supervisors, to coordinate their respective training needs and to oversee the functioning of their respective training efforts. To facilitate this task, the following training related items shall be considered:

- a. Identification of training needs.
- b. Budget input for training requirements.
- c. Development of training courses.
- d. Ensuring training records reflect employee safety and health training.
- e. Effective liaison with the field installation training office, the NASA Safety Division, and the NASA Occupational Health Office.

4. BUDGETING

For the annual budget call, and after consultation with the field installation financial management and personnel development organizations, the field installation safety official and occupational health official will compile the estimated funding requirements in the areas below and submit them to the appropriate budget personnel so that funds can be allocated for the training program. This may be handled by the training office in some cases.

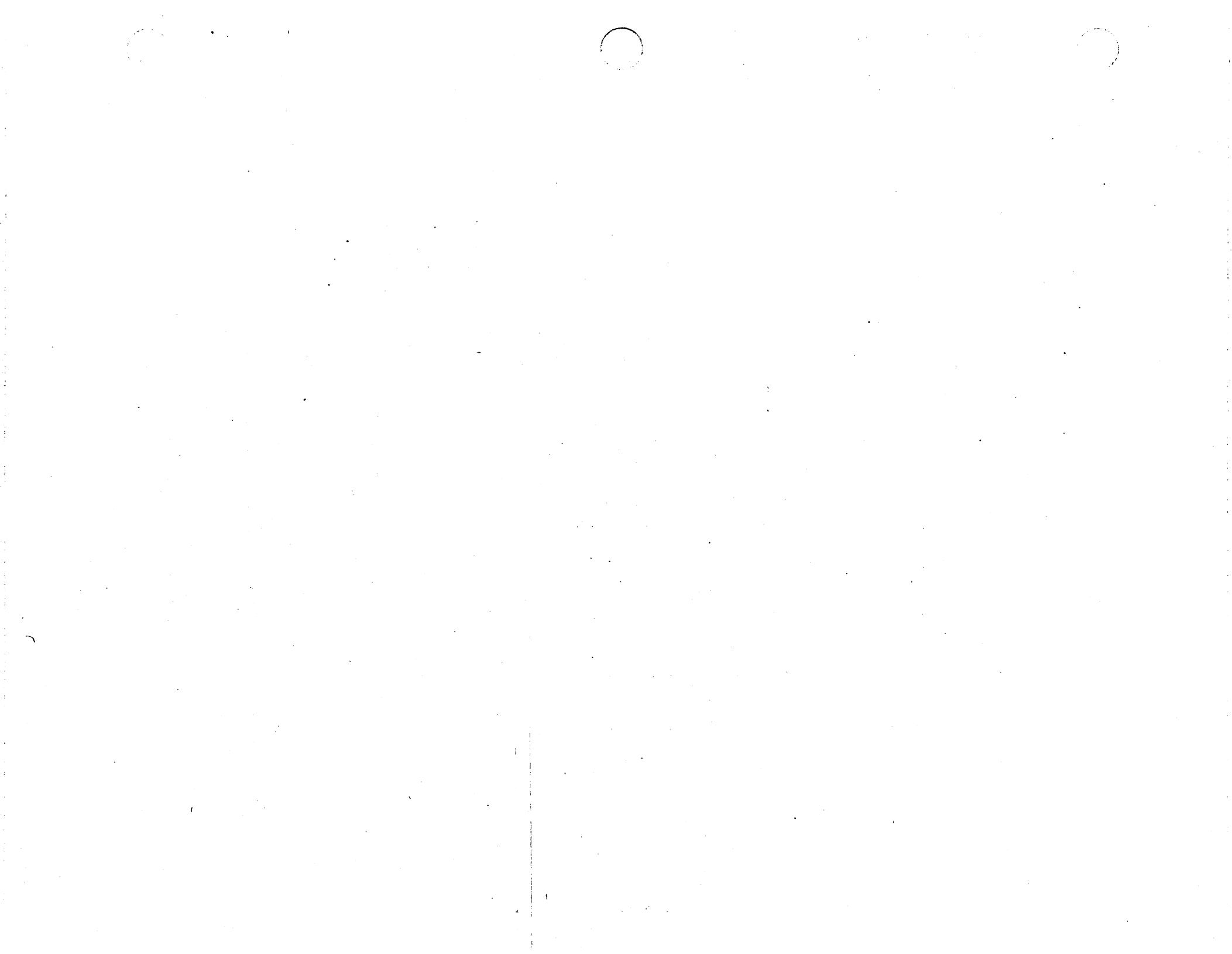
- a. Costs associated with printed matter, visual aids, and course material necessary for training, instruction, orientation, and promotional efforts.
- b. Funds required for vendor supplied courses.
- c. Travel costs associated with training field installation safety and/or health professionals.
- d. Specific costs, related to training, which are part of the safety and/or health professional's career development plan.

5. NASA HEADQUARTERS SAFETY AND HEALTH OFFICES

The role of the NASA Safety Division and NASA Occupational Health Office will be to assist their field installations counterparts in assuring that the requirements of 29 CFR Part 1960 are followed and that the same standardization exists in the uniformity of training emphasis within individual employee categories. They will act as clearinghouses for information regarding available training courses and materials and they will develop, in conjunction with the Office of Development at NASA Headquarters, training courses suited to specific agencywide needs.

6. REPORTING

A summary of the plan, including: budget information, number of employees benefitting, level of effort, specific courses planned for the year, and successes (or dissatisfaction) in courses presented, will be submitted annually (concurrently with data requested for the NASA annual report to Department of Labor) to the appropriate Headquarters health or safety office with sufficient information to evaluate successes of the program and distribute suggestions to other installations to aid them in planning their future programs.



CHAPTER 5: OCCUPATIONAL SAFETY AND HEALTH

5.1 BACKGROUND

The provision of a safe and healthful workplace for NASA employees is a basic management responsibility. Requirements to be met by Federal agencies in this regard are contained in Executive Order 12196, entitled, "Occupational Safety and Health Programs for Federal Employees," dated February 26, 1980. More detailed regulations (29 CFR Part 1960) entitled, "Basic Program Elements for Federal Employee Occupational Safety and Health Program" were issued on October 21, 1980.

5.2 POLICY

NASA's policy for the NASA Safety and Health Programs is found in NMI 8710.2, "The NASA Safety and Health Programs."

5.3 PROGRAM REQUIREMENTS

The details of NASA's Occupational Safety and Health Programs are found in the handbook, "Occupational Safety and Health Programs," NHB 2710.1. The following represents a summary of the major elements of those programs:

1. ADMINISTRATION

The programs are under the direction of the Associate Administrator for Management and the Chief Engineer who are supported by professional staffs in the NASA Occupational Health Office and the NASA Safety Division, respectively. Financial issues regarding safety and health are identified in the NASA Financial Management Manual.

2. STANDARDS

NASA complies with the safety and health standards issued by OSHA pursuant to Section 6 of the Occupational Safety and Health Act. NASA also has provisions for adopting its own standards after appropriate review and coordination with its employees and their representatives. Such standards are reviewed and approved by the Secretary of Labor pursuant to requirements of Executive Order 12196.

3. INSPECTION AND ABATEMENT

NASA conducts inspections of its workplaces at least annually and has a formal program for abatement of hazards. Inspections are conducted by qualified personnel and employees are encouraged to participate in such inspections and to report any unsafe or unhealthful conditions. Employees may report such conditions to a successive level of management if not satisfied that the condition has been properly abated. All mishaps occurring in NASA workplaces are investigated. See Chapter 2 of this handbook for details.

4. HAZARDOUS MATERIAL REQUIREMENTS

NASA has established programs to assure the safety of products which it produces. NASA utilizes the Material Safety Data Sheet (MSDS) system in its procurement of hazardous materials.

5. SAFETY AND HEALTH COMMITTEES

NASA requires the establishment of safety and/or health committees at its field installations although NASA has exercised its option not to utilize the membership format established by OSHA for such committees as set forth in 29 CFR Part 1960, Subpart F.

6. ALLEGATIONS OF REPRISAL

NASA policy prohibits restraint of, interference with, coercion of, discrimination of, or reprisal against any employee for reporting an unsafe or unhealthful condition or for participating in the agency's safety and health programs.

7. TRAINING

NASA provides training for employees, their representatives, supervisors, senior management officials, safety and health staffs, and specific categories of workers engaged in potentially hazardous operations. Details of these requirements and the training programs are found in Chapter 4 of this handbook.

8. RECORDKEEPING AND REPORTING REQUIREMENTS

Detailed records of occupational injuries and illnesses are maintained by NASA. Employees are allowed access to this data and their medical exposure records in accordance with Federal regulations (29 CFR 1910.20). NASA Headquarters requires quarterly reporting of occupational injuries and illnesses from the field centers and the agency reports annually to the Department of Labor. NASA also publishes an annual Mishap and Injury Data summary report for internal NASA use. Additional details on this subject may be found in Chapter 2 of this handbook.

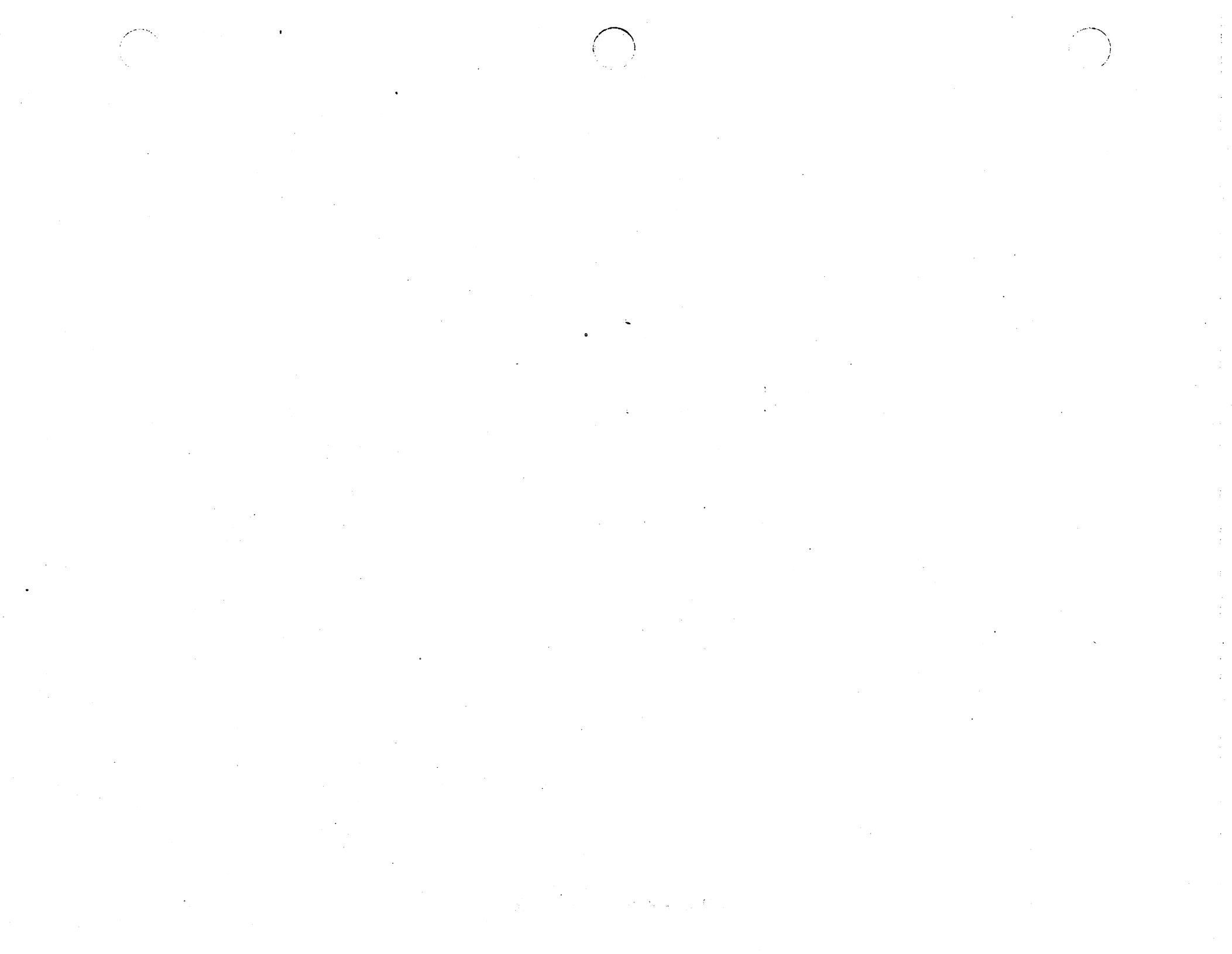
9. EVALUATION OF SAFETY AND HEALTH PROGRAMS

NASA Headquarters conducts biennial surveys of field installations to determine the adequacy of their Safety Programs and annual reviews to determine the adequacy of their Health Programs. NASA also requires field installations to conduct internal reviews of their Safety Program during the years when no Headquarters survey is scheduled (see paragraph 1.9).

NASA is subject to external evaluation of its Safety and Health programs by the Department of Labor in accordance with Federal regulations found in 29 CFR 1960.80.

10. FIELD FEDERAL SAFETY AND HEALTH COUNCILS

NASA encourages participation by both its safety and health professionals and employee representatives in the local Field Federal Safety and Health Council.



CHAPTER 6: PERSONNEL CERTIFICATION REQUIREMENTS FOR POTENTIALLY HAZARDOUS OPERATIONS

6.1 GENERAL

Many NASA operations involve the use of hazardous or exotic chemicals or state-of-the-art technology or contain inherent hazards which could be hazardous to life, the environment, or property in the event of an accident. People who perform or control hazardous operations or use or transport hazardous material must possess the necessary knowledge, skill, judgment, and physical ability (if specified in the job classification) to do the job safely, in a healthful manner, and be certified to do so. This chapter prescribes requirements for that personnel certification.

6.2 APPLICABILITY

This chapter is applicable to all NASA employees and to all NASA contractors, in accordance with the terms of the contract, who may be involved in potentially hazardous operations.

6.3 EXCLUSIONS

1. This chapter does not apply to personnel engaged in skill operations already certified by quality assurance organizations such as soldering, brazing, crimping, potting, etc., and to personnel performing inspections using dye penetrant, magnetic particle, ultrasonic, radiographic, and magnaflux, etc.
2. The certification of equipment and facilities is not within the scope of this chapter but may be equally as important as personnel certification as far as safety is concerned. High pressure systems, safety protective systems, propellant systems, vacuum systems, hoists, cranes, altitude chambers, hyperbaric chambers, etc., should be tested periodically and certified to be capable of safely operating at their rated capacities as they are prescribed by other NMIs, OSHA, and national consensus standards, (such as American National Standards Institute (ANSI), National Fire Protection Association (NFPA), etc.) or other chapters of this handbook.
3. Nothing in this chapter shall be used as a justification for allowing hazardous duty payments, environmental differential pay, or premium pay nor will the fact that a job qualifies for hazardous duty pay imply that it is covered by this chapter. It has always been NASA policy to make all operations as safe as possible, even potentially hazardous testing. For guidance on hazard duty pay differentials, see NMI 3550.2, "Delegation of Authority to Make Determinations Regarding Premium Pay on an Annual Basis," and the Federal Personnel Manual.

6.4 DEFINITIONS

1. HAZARDOUS MATERIAL

Hazardous material is defined in Chapter 10, paragraph 10.4 of this handbook.

2. HAZARDOUS OPERATIONS

Hazardous operations are defined in Chapter 10, paragraph 10.5 of this handbook.

3. HANDLERS OF HAZARDOUS MATERIAL (FOR PURPOSE OF THIS HANDBOOK)

Handlers are those individuals who do not open or otherwise disturb the integrity of the basic, properly packaged, shipping container that holds the hazardous material. As an example, this includes personnel who prepare, package, mark, or transport hazardous material. Personnel who reduce palletized or otherwise combined items into smaller increments, without exposing the hazardous material, are considered handlers.

4. USERS OF HAZARDOUS MATERIAL (FOR THE PURPOSE OF THIS HANDBOOK)

Users are those personnel who open the incremental hazardous material shipping container, thereby exposing the material, for purpose of mixing, transferring, burning, freezing, pouring, venting, reacting, disposing, or otherwise using or altering the material.

6.5 HAZARDOUS OPERATION CATEGORIES

1. Category I hazardous operations are those jobs that potentially have a high degree of immediate hazard to the operator or user, other employees, NASA equipment, facilities, or the public. Additional Category I jobs can be designated by each field installation, but must include the following as a minimum:
 - a. Air Crew Members (FAA licensing may not be sufficient).
 - b. Centrifuge Subjects and Operators.
 - c. Critical Lift Crane Operators, (critical to be determined by the installation in accordance with the replacement value, uniqueness of the material lifted, and the hazards involved).
 - d. Firefighters.
 - e. Propellant or Explosive Users.
 - f. Propellant or Explosives Handlers.

- g. Rescue Personnel.
 - h. Self-contained Atmospheric Protective Ensemble (SCAPE) users.
 - i. Self-contained Underwater Breathing Apparatus (SCUBA) and Other Underwater Divers and Neutral Buoyancy Tank Operators.
2. Category II operations are those that, if not done correctly, could create a severe hazard to the operator or user, other personnel, and/or property. Additional Category II jobs can be designated by each field installation safety or health official or his/her designee, but must include the following:
- a. Altitude Chamber Operators.
 - b. Heavy Equipment Operators.
 - c. High Pressure Liquid/Vapor/Gas System Operators (above 150 psig).
 - d. High Voltage Electricians (above 550V).
 - e. Hyperbaric Chamber Operators.
 - f. Explosive-Actuated Tool Operators.
 - g. Radiation Workers.
 - h. Tank Farm Workers.
 - i. Wind Tunnel Operators.
 - j. Welders.
 - k. Hazardous Material Users (unless covered above in Category I).
 - l. Crane Operators (other than critical lift).
 - m. Riggers for hoisting operations.
3. Category III hazardous operations are those that are involved strictly with the handling/transporting/packaging of hazardous materials and do not otherwise disturb the integrity of the basic, properly packaged, shipping container that holds the hazardous material. Operations that involve the reduction of palletized or otherwise combined items of packaged hazardous material's qualify as handling.
- ## 6.6 CERTIFICATION REQUIREMENTS
- All personnel engaged in potentially hazardous operations at the Category I, II, or III level as determined by line management or field installation safety and/or health officials, will be certified as capable to operate the equipment or perform their jobs in a safe manner.

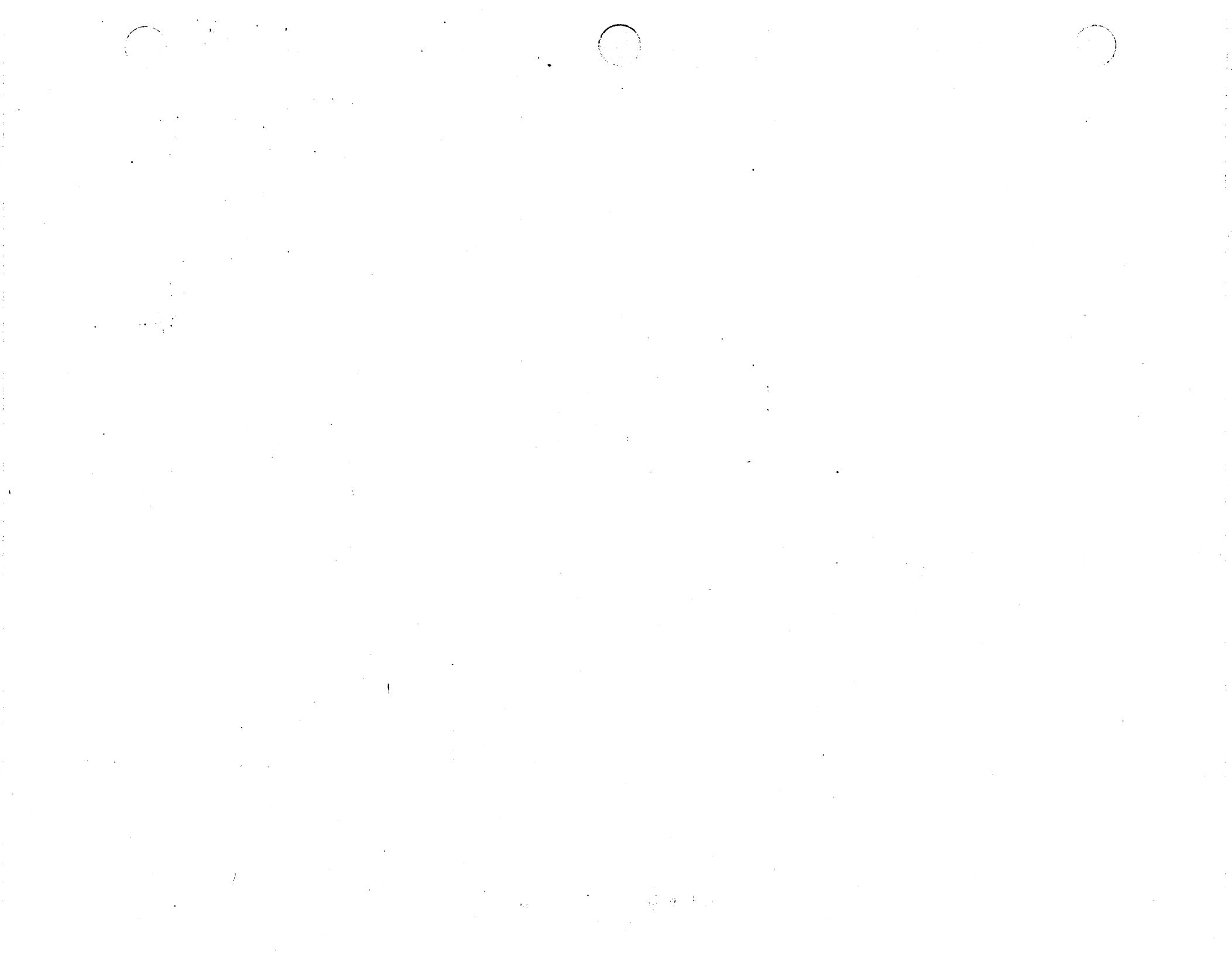
1. For Category I hazardous jobs, the following is required as a minimum for certification.
 - a. Physical examination (see subparagraph 4 below).
 - b. On-the-job training.
 - c. Classroom training (for initial certification and as needed).
 - d. Written examination (as needed).
 - e. Issuance of a certification card or listing on a personnel certification roster.
 - f. Annual retraining that will include review of emergency response procedures and First Aid procedures.
 - g. The Category I Recertification Period will be determined by the installation safety and/or health officials, but shall not exceed a 4 year interval.
2. For Category II hazardous jobs, the certification requirements are left to the discretion of each installation. However, the requirements should be similar to those in subparagraph 1 above, except for appropriate reductions in the levels of examination, training, and testing to be consistent with the lower potential hazard levels of Category II jobs.
3. For Category III hazardous jobs, the following is required as a minimum for certification.
 - a. Specific training in the Federal, NASA, and local rules for preparing, packaging, marking, and transporting the hazardous material associated with the job.
 - b. Examination by written test to determine the adequacy and retention of the training.
 - c. Issuance of a card or license (to be carried on person) listing name, date, materials for which certification is valid, signature of certifying official, and date of expiration.
 - d. Category III recertification period will be as determined by the installation safety and/or health officials in the absence of any state or Federal requirements.
4. Unless otherwise specified, the need for physical examinations for Category I and II jobs either as a means to determine fitness for duty or to assist in establishing baseline or occupational exposure levels will be as determined by the cognizant health official and will be in compliance with the applicable codes, regulations, and standards covering the occupation or environment. The need for fitness for duty examinations

should be based on the hazardous consequences of employee's inability to perform the job correctly due to physical or mental deficiencies.

6.7 RESPONSIBILITIES

The responsibility for overall policy development of the certification program rests with the safety official. Each installation line organization is responsible for managing the certification program for its employees in accordance with the installation policy and the policy in this handbook.

1. The safety official, in conjunction with the health/medical official, will annually review all operations being performed at the installation and identify those that are potentially hazardous in addition to the mandatory listing in subparagraph 6.5-1 and 6.5-2. Employee safety and/or health committees, employee representatives, and other interested groups should be provided a chance to assist in the identification process.
2. The installation health/medical official:
 - a. Is charged with overseeing or conducting the required medical examinations in support of the certification effort and to assure compliance with OSHA or other Federal agency medical monitoring and recordkeeping requirements.
 - b. Will determine the depth, scope, and frequency for medical examinations.
3. Field installations will develop and provide the training courses, training aids, simulators, movies, slides, student handouts, instructors, etc., that may be needed.



CHAPTER 7: SYSTEM SAFETY

7.1 PURPOSE AND OBJECTIVES

1. This chapter outlines the NASA requirements specified in NHB 1700.1 (V3), "System Safety," for developing and implementing System Safety Programs to assure that reasonable measures have been taken to minimize risks to people and property.
2. System safety prescribes the overall approach to risk evaluation by:
 - a. Systematically identifying the hazards of a defined set of hardware and software. This includes all phases of development and operations such as design, manufacture, test, transportation, storage, usage, maintenance, modifications, disposal, etc.
 - b. Eliminating these hazards insofar as is possible. If the hazards cannot be eliminated, taking all practical steps to control them in a timely, cost-effective manner.
 - c. Assessing the risks remaining as inherent in the system or operation during its intended life.
 - d. Providing the safety risk assessments to the appropriate management level for a decision to either resolve the hazard or assume the risk.
 - e. Documenting the management decision and rationale regarding acceptance of risk.

7.2 APPLICABILITY

1. It is NASA policy to implement System Safety Programs for system acquisitions, in-house developments, facility design/modifications, and agency operations and activities to achieve the highest degree of safety in the planning and design of a system or operation consistent with mission and program requirements.
2. System safety requirements shall be tailored consistent with the system characteristics, hardware complexity, unit cost, stage of development, program management structure, supplier experience, and relative criticality of hardware to the safety of the mission. Tailoring may take the form of addition or revision to or deletion of the requirements described herein.
3. Tailored System Safety Programs shall be initiated during the concept phase and shall address all aspects of the life cycle of:
 - a. Aeronautical systems.
 - b. Flight systems (e.g., STS, expendable launch vehicles, and sounding rockets).
 - c. Spacecraft (payloads).

- d. Facilities.
- e. Support equipment, including ground and airborne, test, maintenance, and training equipment.

- f. Related software.

- g. Operations and supporting activities, including:

- (1) Construction, fabrication, and manufacture.
- (2) Experimentation and test.
- (3) Packaging and transportation.
- (4) Storage.
- (5) Checkout.
- (6) Launch, flight, and use.
- (7) Maintenance.
- (8) Modification.
- (9) Retrieval, disassembly, and disposal.

7.3 SYSTEM SAFETY MANAGEMENT AND ORGANIZATION

Management has the responsibility for organizing system safety management, implementing system safety policies, incorporating safety requirements, and considering risks in making the required decisions. The management emphasis placed on safety during design, manufacture, test, and operations has a direct influence on the degree of safety that can be achieved. To carry out the system safety function effectively, regardless of the size of the effort, a system safety manager should be designated by the appropriate management office to plan, organize, implement, and supervise the system safety effort conducted in-house and by contractors and to keep management informed of the status of the system safety effort and the risks based on the output of the hazard analyses. The system safety effort should be organized early in the planning phases so that it can be responsive to the decisionmaking process. The system safety effort may be staffed as part of the project organization, the field installations' quality assurance organization, the design engineering organization or other organization if objectivity can be assured.

7.4 SYSTEM SAFETY PLAN

The initial planning of the system safety program should be conducted early in the concept phase of a program. It is in effect a "road-map" for future system safety activities. To support the planning effort, a preliminary hazard analysis should be conducted on each proposed alternative concept, whether explored by the program office and field installations or competitively. The preliminary hazard analysis should document the inherently hazardous characteristics associated with each operational and support concept being

considered. The preliminary hazard analysis should include an accident analysis of similar systems. The results of the analyses provide a basis for evaluating the safety of each alternative concept and for defining safety requirements, and criteria and future plans applicable to the development of the selected concept. The system safety plan should establish the system safety management and engineering tasks to be conducted in-house and by contractors and provide a basis for allocation of resources and budget. The program system safety plan should be revised, as required, to meet the changing needs of the overall program.

7.5 SYSTEM SAFETY MILESTONES

The output of the system safety effort must be timely and tied to the overall project milestones to influence the decision process and affect the system design or operational concept being developed. Hazard analyses should be conducted to support "trade" studies of proposed alternative concepts. The system safety effort should expand with the evaluation of prototypes for concept definition with the effort reaching its peak during the design/development period. Cognizance of changes to the overall project schedule is essential so that the system safety milestones can be adjusted accordingly. The System Safety Program schedule may have to be tightened or relaxed depending on the schedule and engineering activities of the overall project.

7.6 SYSTEM SAFETY CRITERIA

NHB 1700.1(V3) provides details of the basic system safety program requirements applicable to the facilities and system acquisition process and subsequent operational phases. In the implementation of the basic requirements, consideration must be given to the tailoring of requirements to the specific system and to the particular program needs. Tailored system safety program requirements currently exist in NHB 5300.4(ID-2), "Safety, Reliability, Maintainability, and Quality Provisions for the Space Shuttle Program," and in NHB 1700.7, "Safety Policy and Requirements for Payloads Using the Space Transportation System (STS)," for the STS payloads and their ground support equipment.

7.7 HAZARD ANALYSES

Hazard analyses shall be performed and documented to provide an assessment of the risks associated with the system or operation being evaluated. The hazard analyses shall provide a qualitative or quantitative basis for systematically and objectively evaluating the foreseeable or predictable harm that is likely to occur. Quantitative analysis shall be performed only where the risks of parts/components failures and human errors for the operational environment are known with reasonable confidence and the criticality of alternative designs is sufficiently important to safety. The type of analysis performed will be largely dependent on the definition of the system or operation. A preliminary hazard analysis should be performed during the conceptual phase to evaluate alternative concepts and to establish safety requirements. As the design matures, the hazard analysis effort should be expanded to include a detailed analysis of the subsystems and in turn the total system for each design iteration. The operational safety analyses, beginning with the operational concept and ultimately reflecting the operational

configuration, should address hazardous events associated with the performance of fabrication, assembly, test, checkout, launch, use, maintenance, and disposal.

7.8 HAZARD ELIMINATION AND CONTROL

The foremost consideration for resolving hazards shall be the elimination of hazards by design. Considering the time and dollar constraints of the program, however, priorities for corrective actions and hazards resolutions may have to be established to achieve maximum benefit in reducing potential personnel and material losses. Hazards which cannot be eliminated by design shall be controlled by corrective action taken in the following order of precedence.

1. Design for minimum hazard.
2. Install safety devices.
3. Install caution and warning devices.
4. Develop administrative controls, to include special procedures and training.
5. Provide protective clothing and equipment.

7.9 MANAGEMENT ACCEPTANCE OF SAFETY RISK

The decision on whether to assume a risk is clearly a management responsibility, but must be consistent with social acceptance of the risk. Management—whether a system project manager, facilities project manager, test or operations director—must assume certain risks that are attendant to the design, manufacture, test, or operation to accomplish the intended mission effectively. The acceptance of these risks should be based on thorough visibility of the nature of existing hazards and risks and the options and alternatives to the acceptance of the risks. Because the acceptability of most risks is judgmental in nature, the organizational procedures and review process should provide for a free flow of information among management, engineering, manufacturing, testing, and operating personnel so they can evaluate the perceived risk from different points of view. The decision to accept a safety risk will be documented (see paragraph 7.11).

7.10 PROGRAM SAFETY REVIEWS AND AUDITS

1. Presentation of the system safety program status and safety assessment reports should be scheduled for major decision points such as the preliminary design review, critical design review, design certification review, and first article or customer acceptance configuration inspection. For readiness reviews such as test, operations, launch, and flight, an independent assessment by "third party" experts, e.g., engineering, manufacturing, testing, and operating personnel outside the normal organization channels, shall be provided to aid in hazards' identification and risk assessment.

2. For major projects, system safety audits by "third party" teams should be conducted, as a minimum, annually to evaluate:
 - a. Performance compared to the plan.
 - b. The success with which risk to people and property are identified and controlled.
 - c. The extent to which the system safety output influences program decisions.
3. The biennial Safety, Reliability, and Quality Assurance Survey conducted by NASA Headquarters is one of the means of satisfying the need for an annual independent assessment. The required off-year internal "third-party" survey can also satisfy this requirement (see subparagraph 1.9-3c). Other special surveys may be required for some high risk systems and for changes in the system or operational mode to assure that safety risks are properly addressed.
4. For major facility projects, a review of the facility design and operational concepts by the NASA Operations and Engineering Panel (OEP) should be considered during the detailed design phase.

7.11 SYSTEM SAFETY DOCUMENTATION

The System Safety Program shall be traceable from the baseline safety requirements, criteria, and effort planned in the conceptual phases through program completion. Management and technical changes that impact on the established safety level shall be documented. Plans such as project plans, test plans, and operational plans submitted to solicit management approval shall address the risks. Approval of the plan will therefore constitute baselining of hazards. Also, all pertinent details of the hazard analysis and review shall be traceable from the initial identification of the hazard to its elimination or control. Adequate resolution of the hazard shall be verified and management acceptance of the risk on a one-to-one basis shall be documented to provide a complete audit trail. A safety assessment report (SAR) (this differs from the SAR in Chapter 8) documenting a summary of the hazard analyses and a statement of the risks that may be incurred by operation of the system shall be submitted to management to provide risk visibility for program and readiness reviews. Waiver requests for exemption from safety requirements should be maintained on a formal basis with each waiver concurred with by management and the circumstances of its issuance fully documented.

7.12 SAFETY REVIEW OF CHANGES

A major source of safety degradation in any system, once a safety level has been established, is through changes to that system. Accordingly, each proposed hardware or operational change must be subjected to a safety review or analysis as appropriate to assure that it does not create a hazard. Changes proposed to correct a safety problem should also be analyzed to determine the amount of safety improvement (or detriment) that would actually result from incorporation of the change.

7.13 SAFETY "LESSONS LEARNED"

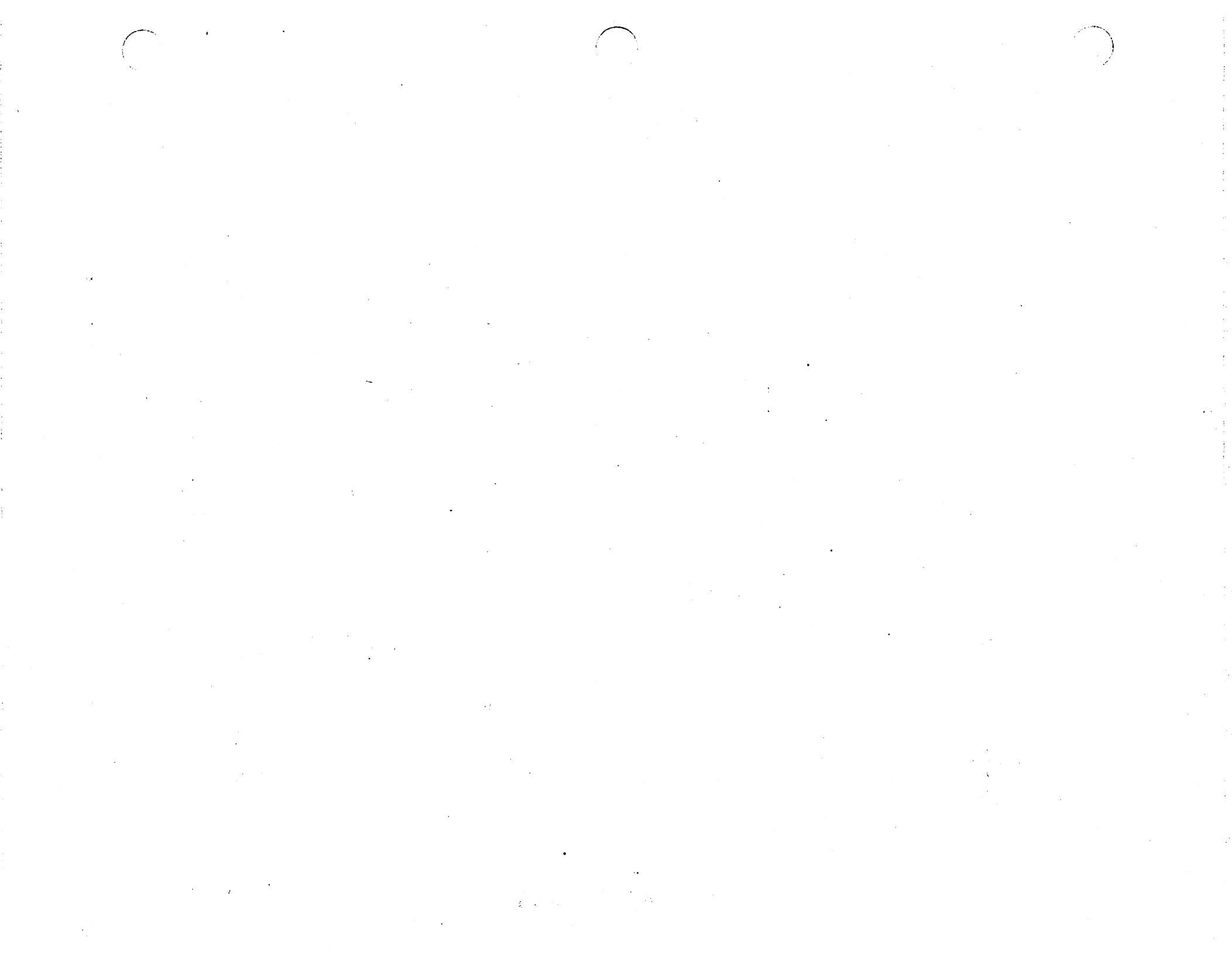
Safety "lessons learned" generated during the performance of management and technical functional activities should be disseminated within the installation and throughout NASA field installations and Headquarters to improve understanding of hazards, preclude the occurrence of similar accidents, and suggest better ways of implementing system safety programs. Centers should maintain hazard lists or checklists which address safety requirements and concerns peculiar to their programs and activities. Safety "lessons learned" should be included in program, procurement, and Center newsletters to communicate more effectively with management. "Lessons learned" which indicate the need for revising source documents (e.g., instructions, handbooks, specifications, and standards) should be submitted directly to the preparer of the document. Existing media which should be used for disseminating "lessons learned" include:

1. NMI 5310.1, "Alert—Reporting of NASA Parts, Materials, and Safety Problems."
2. NMI 5310.2, "Participation in Government-Industry Data Exchange Program (GIDEP)."
3. Summaries forwarded with Board of Investigation Reports (see Chapter 2 of this handbook).
4. NASA Experience Bulletin, distributed agencywide by NASA Headquarters, Office of the Chief Engineer.

7.14 PROCUREMENT CONSIDERATIONS

1. Procurement for design, development, fabrication, test or operations of systems, equipment, and facilities should include appropriate system safety requirements in the Statement of Work and the Request for Proposal (RFP).
2. Contractual requirements must be specific so that the contractor clearly understands what is expected to be accomplished. In addition, this provides the contractor with a definitive basis for budget estimates included in the cost proposal and assures the government that resources have been planned to implement the system safety program requirements. The preliminary hazard analyses performed in-house (reference paragraph 7.4, System Safety Plan) defines safety design criteria and requirements to include in the RFP.
3. Ideally, the program system safety plan developed in-house should be included as an exhibit of the RFP to provide the contractor with direction concerning the organization/system interfaces and integration. The contractor can then respond in the proposal with a system safety plan applicable to appropriate portions of the overall plan or, where appropriate, integrate safety requirements into other plans required by the RFP.

4. The contractor's technical and cost proposal should be evaluated on the basis of a demonstrated understanding of the RFP requirements as well as on the contractor's cost and performance history pertaining to system safety.
5. Agreed to revisions of the contractor's system safety plan during contract negotiations allows for implementation of an approved plan immediately upon contract award. The approved contractor systems safety plan would be an attachment to the contract, referenced in the Statement of Work, and would become the basis for contractual requirements.
6. For guidance on contracting see Chapter 3 of this handbook and the NASA Procurement Regulation, Part 1, subpart 52 and Part 14, subpart 6.



CHAPTER 8: NUCLEAR SAFETY FOR SPACE SYSTEMS

8.1 SCOPE

1. This chapter outlines NASA procedures and interagency review and approval requirements for the use of radioactive materials in spacecraft and the Space Transportation System.
2. This chapter does not include procedures, requirements, or licensing details for using, storing, shipping, or handling radioactive materials in ground-based facilities or activities or in preparation for space uses. These materials will be handled pursuant to directives issued by the NASA Occupational Health Office. (At the launch site, normally Kennedy Space Center (KSC), many activities fall within the scope of space activities, and when nuclear power systems covered by agreements are used at NASA or at NASA contractor facilities, some special conditions may require compliance with space related guidelines; however, these instances and procedures will be determined on a case-by-case basis.)

8.2 DEFINITION OF DOCUMENTATION

1. SAFETY ANALYSIS REPORT (SAR)

A safety report of considerable detail prepared by the contractor detailing the safety features of a particular nuclear system or source. The SAR is submitted to the Interagency Nuclear Safety Review Panel (INSRP) for review.

2. SAFETY ANALYSIS SUMMARY (SAS)

A safety report of less detail than the SAR prepared and reviewed in the same manner as the SAR.

3. SAFETY EVALUATION REPORT (SER)

A safety report prepared by the INSRP detailing the safety of a particular source or system based on their own assessment of the contractor supplied SAR, SAS, and other data.

4. OVERALL SAFETY MANUAL (FOR INSRP)

A guideline document prepared by the NUS Corporation for the Department of Energy in support of the INSRP to provide generic data and requirements for preparation of the above listed documents.

8.3 GUIDELINES

1. Each program/project will comply with pertinent directives, licenses, agreements, and requirements promulgated by NASA, Department of Energy (DOE), Nuclear Regulatory Commission (NRC), and Office of Science and Technology Policy (OSTP), Executive Office of the President.

2. Specific guidance for preparing necessary documentation for presentation to the INSRP will be provided by the INSRP. For NASA operations, the level of detail required and the decision to waive certain requirements (usually because the information is available to the INSRP from other sources or the unit is small enough or well enough understood from previous uses to justify the waiver) will be made by the NASA coordinator of the INSRP (Manager, Nuclear Safety, Office of the Chief Engineer, Code D, hereinafter referred to as the NASA coordinator) in consultation, as necessary, with other INSRP coordinators and members. Program/project personnel are urged to confer with the NASA coordinator as soon as the use of radioactive power units, heat sources, or other large sources are tentatively selected for use on NASA spacecraft.

8.4 RESPONSIBILITIES

1. The safe use of radioactive materials is a program/project/individual responsibility supported by appropriate safety and health personnel. The use of radioactive materials in spacecraft requires adequate planning and design to avoid injury or unacceptable exposure for normal or abnormal conditions, including launch aborts with uncontrolled return to Earth.
2. Programs/projects will designate individuals who will coordinate the nuclear safety development and documentation requirements with the suppliers (DOE, contractors, or in-house offices), the NRC, the supporting organization, the NASA coordinator, and finally the INSRP.
3. The NASA Coordinator will review all NASA space uses of radioactive materials.
 - a. The categories of small sources are defined in the June 16, 1970, National Aeronautics and Space Council document, "Nuclear Safety Review and Approval Procedures for Minor Radioactive Sources in Space Operations." This information is available at each Installation and includes a typical quarterly report and a "Safety Analysis Summary (SAS)" for a Category "A" source (one of the larger sources which can be approved with a minimum of documentation).
 - b. Small sources (as defined in the June 16, 1970, document) may be approved by the NASA coordinator, and he/she will notify appropriate individuals and organizations with copies of the quarterly report sent to the OSTP. Data to be included in the report to the coordinator must include, preferably in table form, spacecraft, launch schedule, launch site, number of sources, isotopes, total activity, category, and remarks (e.g., orbit, duration, plans to recover sources, burnup, or other pertinent information).
 - c. Heat sources and nuclear power sources for space require a detailed "Safety Analysis Report (SAR)" and an extensive review by the INSRP. The program/project office is responsible for preparation and justification of the SAR. The DOE and contractors normally provide the majority of the nuclear related data; a DOE contractor normally assembles the information and writes the SAR's for DOE and the user organizations. Requirements and guidelines for preparing SAR's are available from the INSRP and include detailed

guidelines, technical models, reference data, instructional materials, and other pertinent information. Much of this information is contained in the four volumes of the "Overall Safety Manual" which was prepared for the INSRP by a DOE contractor and is available from DOE.

- d. Since preparation of a SAR is expensive, time consuming, and requires very specific information for review and approval, careful coordination with the NASA coordinator and DOE program personnel prior to beginning the safety documentation is important.

8.5 INTERAGENCY REVIEW AND LAUNCH APPROVAL

1. The INSRP becomes involved in the very early stages of development and follows development activities related to nuclear power systems and nuclear heat sources. Subpanels review designs, analyses, and test activities. Anticipated environments for normal and abort conditions are analyzed and tests to determine nuclear system survivability are conducted by DOE.
2. The NASA coordinator interfaces with program/project personnel and provides guidance to assure that INSRP requirements are understood and adequate information is provided for review. The coordinator selects the NASA members of the INSRP and its subpanels and requests support (travel, funding, technical, and test facilities as necessary) for the nominees through the NASA Field Installation Directors. The NASA coordinator is responsible for the overall NASA participation during the review, to include the generation of any SER's.
3. The SER is the basic document reviewed by the agencies' managers in preparation for recommending launch approval to the Office of Science and Technology Policy (OSTP), Executive Office of the President. The NASA Administrator submits the request for launch approval. Approval is granted by the President through the OSTP or, in some circumstances, the OSTP can grant approval.

8.6 LAUNCH PREPARATION

1. Although the launch of radioactive sources is controlled by special requirements, the development and prelaunch phases are controlled by licensing requirements. Special phases are also controlled by licensing requirements or by special agreements and exemptions. Contractors are required to meet applicable state, federal, and Nuclear Regulatory Commission (NRC) requirements. Government organizations must normally comply with NRC licensing requirements. Exceptions occur where agencies or their contractors are exempt through appropriate agreements with DOE or by regulation, such as some DOD activities.
2. At NASA installations, all radioactive material uses will comply with the agency/installation regulations in addition to other licensing requirements. Unless specifically exempted, most radioactive materials must be controlled and licensed, except some very small sources.

3. The large power and heater units owned by DOE require special handling and they normally are monitored by DOE and contractor personnel. In some instances, NASA personnel are designated as custodians, but the procedures are approved by NASA and DOE. Installation of the units onto the spacecraft and/or transportation systems is carefully controlled, safeguards are required and followed, and emergency plans are kept current.

8.7 RADIOLOGICAL CONTROL CENTER

1. During the immediate prelaunch phase and during launch and early mission operations when nuclear power or heater units are involved, a Radiological Control Center (RADCC) will be manned with specialists from DOD, DOE, NASA, and other agencies, as necessary, to provide technical support in the event of a system failure. Radiation monitoring teams, specially equipped aircraft, decontamination teams, and other specialists will be included as appropriate. NASA funding for special support is provided by the launch installation or, in some abort events, from special funds through NASA Headquarters.
2. In the event of ocean impact, special search efforts for the nuclear sources will be conducted as part of the Range Recovery operations. It is mandatory that underwater sound generators be included on or in the immediate proximity of the nuclear sources to aid in search efforts in the event of water impact. If the launch vehicle has proven underwater sound generators as part of its normal equipment, these may replace the ones required for the nuclear units. The NASA coordinator will support these activities and interface with DOE and DOD in regard to any nuclear concerns. He/she will not replace the normal range interface. Details of the RADCC operations and launch abort plans are found in separate documentation available at the launch site.
3. Special off-site monitoring and cleanup teams are required in the event of radioactive material release during an abort. Since specialists from other agencies and contractors will be used, their efforts will be coordinated by RADCC personnel. The launch installation will, however, have the primary responsibility for all aspects of these launches unless and until specifically released from that responsibility by the NASA Administrator for some phases of cleanup. This could occur, for example, if DOE accepted responsibility for directing off-site decontamination and cleanup.

CHAPTER 9: FIRESAFETY

9.1 GENERAL

1. Thousands of people are killed and billions of dollars of property damage are sustained in the nearly three million fires which occur each year. The number of fires and the magnitude of losses at NASA field installations can only be reduced through the implementation of a comprehensive Fire Protection Program. This chapter contains requirements and guidelines to ensure a consistent and comprehensive approach to firesafety within NASA. It also attempts to resolve conflicting requirements that are contained in the documents that have been used to determine fire protection policy within the agency.
2. The effective implementation of a Fire Protection Program at NASA requires a high degree of commitment and participation by all levels and groups within the employee population. Most important to this goal is senior management support for the Fire Protection Program. Along with a forceful role for the field installations safety office, active employee involvement is also essential to achieve firesafety goals. Periodic training, coupled with imaginative promotional efforts, will help to ensure continued awareness of fire hazards and stimulate interest by all employees to strive for a more fire-safe work environment.
3. The field installation safety organizations are given major responsibilities for the implementation of the Fire Protection Program. They include:
 - a. Identification of fire safety deficiencies through periodic facility inspections;
 - b. Documentation of inspection findings;
 - c. Participation in the decisionmaking process at the field installation for correcting deficiencies;
 - d. Control of flammable material and hazardous operations;
 - e. Review of maintenance procedures for fire protection equipment and systems;
 - f. Fire safety training and development of emergency action plans and fire prevention plans (29 CFR Part 1910 Subpart E);
 - g. Functioning of the field installation fire department (where applicable);
 - h. Investigation of fires; and
 - i. Informing senior management of developments within the Fire Protection Program.

4. Within NASA there exists a broad base of fire protection experience as well as common fire safety problems. NASA as a whole can benefit from both this experience and the awareness of effective approaches that have been taken by other field installations to solve similar problems. This benefit can be realized through intercenter communication and by the utilization of the NASA Safety Division as a clearinghouse for fire safety information.
5. The NASA Safety Division will facilitate the achievement of fire safety goals by:
 - a. Advocating fire protection in Construction of Facility (CoFF) projects;
 - b. Supporting field installation budget submittals dealing with fire protection;
 - c. Providing technical assistance when needed;
 - d. Reviewing field installation fire protection during Safety, Reliability and Quality Assurance (SR&QA) surveys;
 - e. Reviewing the adequacy of design, from a code compliance, contractual, and cost benefit standpoint, of major construction projects; and
 - f. Providing financial support for fire risk analyses and similar studies.

9.2 LEGAL REQUIREMENTS, CODES, AND STANDARDS

1. GENERAL

Recently promulgated requirements in Subpart "C" of the Basic Program Elements for Federal Employee Occupational Safety and Health Programs (29 CFR Part 1960), mandate that NASA "...comply with all occupational safety and health standards issued under Section 6..." of the Occupational Safety and Health Act or with alternate standards issued pursuant to the Subpart. Concerning fire protection, regulations contained in the general industry standards (29 CFR Part 1910) for means of egress (Subpart E), hazardous materials (Subpart H), fire protection (Subpart L), welding (Subpart Q), and electrical (Subpart S), are primary sections for compliance.

2. REQUIREMENTS

With the goal of protecting life and property, the requirements of the following documents must be complied within the design, construction, and operation of all buildings and structures within NASA:

- a. The Facilities Engineering Handbook, (NHB 7320.1).

- b. National Fire Protection Association, (NFPA), National Fire Codes (NFC), Volumes 1-16, current edition except where modified by the NASA Safety Division. (Standards only are mandatory. Use of NFPA recommended practices contained in the NFC is encouraged, but is not mandatory.)

3. ALTERNATE STANDARDS

If a field installation elects to apply an equivalent fire safety standard(s), the appropriate safety official will notify the NASA Safety Division in writing of the details of such standard(s) and will include the associated building structure or operation, in accordance with the procedures outlined in the handbook "Occupational Safety and Health Programs," NHB 2710.1.

4. REFERENCE DOCUMENTS

The following documents may be used as references:

- a. Factory Mutual Handbook of Industrial Loss Prevention.
- b. Factory Mutual Loss Prevention Data Sheets.
- c. National Fire Protection Association's Fire Protection Handbook.
- d. Life Safety Code Handbook.
- e. National Electrical Code Handbook.
- f. The Flammable and Combustible Liquid Code Handbook.

5. RETROACTIVE APPLICATION

- a. OSHA requirements, building codes, the National Fire Codes, and NASA internal requirements are periodically revised to reflect changing conditions and knowledge about fire protection. This presents a significant problem when the current editions of these documents are utilized to evaluate existing NASA facilities.
- b. To deal with problems associated with retroactive code enforcement, a modified "Grandfather Principle" will be implemented as follows:
 - (1) January 31, 1971, is established as a reference date (the approximate date of publication of the first edition of the Facilities Engineering Handbook, NHB 7320.1). Fire safety deficiencies, that are directly attributable to changing code requirements, in facilities that had been constructed or completely rehabilitated since January 31, 1971, are not required to be corrected immediately unless the Risk Assessment Code (RAC) for that condition is determined to be 1 or 2 (as defined in Chapter 1 of this handbook (paragraph 1.12)). Correction of deficiencies categorized as RAC 3 or 4

may be deferred until the next scheduled rehabilitation or modification, but other control measures must be implemented to minimize hazards.

- (2) For those facilities constructed or rehabilitated prior to January 31, 1971, the most immediate comprehensive fire safety evaluation made after the publication of this handbook will serve as the benchmark for the required level of fire safety. Subsequent surveys, which identify deficiencies attributable to new code requirements, will treat such deficiencies as described in subparagraph b(1).

9.3 FIRE PROTECTION INSPECTIONS

1. All areas and operations of each NASA workplace will be inspected at least annually in order to:
 - a. Comply with 29 CFR Part 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs;"
 - b. Identify existing fire safety deficiencies associated with facility construction and operation;
 - c. Form the basis for both short and long term repair, rehabilitation, modification, and construction; and
 - d. Facilitate the early recognition and correction of life and property threatening fire hazards.

The conduct of the inspection will be in accordance with the guidelines provided in Chapter 4 of the handbook "Occupational Safety and Health Programs," NHB 2710.1.

2. The annual fire safety inspection is not intended to be an all-encompassing engineering survey, but rather an effort to discover readily apparent fire hazards associated with normal facility operations. The inspection should cover the following building features:
 - a. Means of egress.
 - b. Vertical fire integrity.
 - c. Manual and automatic alarm systems.
 - d. Manual and automatic fire suppression equipment.
 - e. Heating, ventilation, and air conditioning systems.
 - f. Exit illumination and emergency lighting and power systems.
 - g. Hazardous operations and materials.

b. Elevators.

Periodically, such as prior to major rehabilitations or modifications, a comprehensive fire protection engineering survey should be conducted of all major NASA facilities.

3. To help assure that the above items are evaluated, the use of a locally generated standard report form or fire safety checklist is encouraged.
4. It is also necessary to obtain a Center-wide perspective by analyzing common conditions which may have an impact on all facilities. These would include: the adequacy and reliability of the water supply, fire department response, alarm monitoring equipment, emergency procedures, and common fire safety deficiencies. Field installation efforts to achieve this goal will be supported by fire risk analyses funded by Headquarters.
5. Judgemental decisions will be required of the inspector or engineer. These decisions must be based on the realization that certain minimum life and fire safety precepts must not be compromised, such as: adequacy of exits; vertical fire integrity; and the segregation and/or protection of hazardous materials and operations. The enforcement of less critical requirements shall be tempered by the realization that less costly but comparably effective solutions can be found for numerous fire protection problems.
6. For those deficiencies that cannot be corrected within 30 days, a hazard abatement plan, as required by 29 CFR 1960.30, will be developed. For more information on development of hazard abatement plans, see paragraph 4.7 of the handbook, "NASA Occupational Safety and Health Programs," NHB 2710.1.

9.4 NEW CONSTRUCTION/REHABILITATION/MODIFICATION

1. Compliance with the appropriate fire safety and life safety codes and standards is the responsibility of each field installation Facility Engineering Office. NASA fire protection and safety personnel shall monitor this compliance effort and involve themselves in the various phases of the facilities projects. For projects costing over \$75,000, the safety and/or fire protection personnel's involvement in the process is required and will include review and concurrence with project documents including but not limited to hazard analyses, design concepts, plans, drawings and reports, and final acceptance. For projects under this ceiling, the involvement may be formal or may be less formal depending on the impact of fire/safety policy and regulatory considerations on the project.
2. This mandate does not explicitly require or imply any radical changes in design and construction procedures. It will necessitate, where not already present, the establishment of specific procedures to include the appropriate individuals within the field installation safety organization into the project phases. It will require, where not already existing, the

development of procedures to route: Concepts, Scopes of Work, Preliminary Engineering Reports, Specifications, Contract Drawings, Change Orders and Working Drawings through the safety office to permit the necessary level of review and concurrence. The contracting facilities engineering and safety offices must coordinate appropriate inspection and testing during critical phases of the construction process. And finally, it requires concurrence by the safety office prior to final payment to the contractor and permanent occupancy of the facility to assure that all life safety and fire safety systems included in the contract are installed and functioning properly in accordance with the contract specifications.

3. It is the intent of this Chapter to recognize the current edition of the Facilities Engineering Handbook as the primary policy document for the design and construction of NASA facilities. The above in no way diminishes the role of Life Safety Code, (NFPA 101), in particular, or the National Fire Codes in general. The current editions of these standards must still be enforced inasmuch as many provisions therein are found in regulatory requirements (e.g., 29 CFR Part 1910 Subpart E, "Means of Egress") for which NASA has no option but to follow. They form the basis for facility evaluations during fire safety inspections. In addition, the appropriate provisions of these standards will be referenced in project specifications and drawings to ensure construction contract compliance.
4. The NASA SPECSINTACT (Specifications Kept Intact) Standard Construction Specifications will augment the above criteria by providing detailed guidance in the preparation of project construction documents. The content and use of the SPECSINTACT System is described in the SPECSINTACT Users Guide.
5. Where any degree of conflict exists among the various requirements of the Facilities Engineering Handbook and the National Fire Codes, the most stringent of the requirements shall apply, unless a thorough engineering study can verify that the level of fire safety will not be significantly diminished by the adoption of the less stringent requirement.
6. Despite the particular standards or criteria that are being enforced, it must be realized that certain basic fire safety requirements must never be compromised in the design or construction of any NASA facility. These requirements include:
 - a. Adequacy of Exits. The exits shall be located and arranged such that in the event of a fire or other mishap, each employee will have access to at least two exits (in case one should be rendered unusable), remotely located (to prevent both from being rendered unusable due to a single fire/emergency condition), without having to travel via a single path for more than 50 feet ("Dead End" and/or "Common Path of Travel" limitation). Exit travel via designated stairways shall be such that a fire located on one floor will not preclude the use of that

- stairway by building occupants (enclosure requirement). Major paths of exit travel, including corridors and stairways, shall be provided with appropriate exit signs and both normal and emergency illumination.
- b. **Vertical Fire Integrity.** Excluding highly specialized structures where compensating protection would be required, facilities shall be constructed and maintained such that a fire on any one level will not propagate vertically via unprotected floor, stairway, or shaft openings, and thereby threaten employees on adjacent levels.
- c. **Noncombustible Construction.** No structural components or interior finish will be employed which will significantly increase the fire hazard to employees from the standpoint of flame spread, smoke development, or fuel contribution.
- d. **Compatible Building Systems.** The design of facility mechanical, plumbing, and electrical systems will be such that no feature of said systems will compromise any aspect of the facility life and fire safety systems and equipment.
- e. **Fire Department Access and Operations.** Facilities will be located and designed with due consideration for fire department apparatus and equipment accessibility as well as both interior and exterior firefighting operations.
- f. **Fire Department Notification:** All facilities will be equipped with a reliable mechanism for summoning the fire department. Where high value equipment, structures, or significant human occupancy are involved, this mechanism shall feature automatic alarm signal transmission (initiated via automatic or manual fire alarm and/or fire suppression systems) to a constantly attended central receiving area.
- g. **Interior Fire Alarm.** In facilities that are constructed or arranged in such a manner that a fire related mishap will not be readily apparent to building occupants by virtue of significant interior partitioning, multiple floor levels, or high ambient noise levels, and thus posing a threat of possible entrapment, a fire alarm system featuring bells, horns, red-rotating beacons, or flashing lights, as appropriate, will be installed.
- h. **Protection of Hazards or Essential Equipment.** Entire facilities or definable areas within facilities susceptible to destruction or loss due to fire that contain significant hazards, high value (greater than \$1 million) or critically important/mission essential equipment, or a combination of the above will be protected by automatic fire detection systems, automatic fire suppression systems, physical separation, and/or segregation by fire walls. Specific details and criteria are found in Vol. 9 of the Safety Manual, NHB 1700.1(V9) soon to be published.

9.5 EMERGENCY ACTION/FIRE PREVENTION PLANS

1. In accordance with the requirements contained in Section 1910.38 of Subpart E of OSHA's General Industry Occupational Safety and Health Standards, and in conjunction with the development of other nonfire, emergency-type procedural plans at NASA field installations, a comprehensive fire emergency plan will be issued by all field installations. Such plan may be an appendix to installation's emergency preparedness plans.
2. A written plan will be structured to suit local conditions, but must include elements listed in 29 CFR Part 1910.38(a)(2).
3. The development of this plan necessitates a degree of coordination with other Federal agencies or private contractors when they occupy facilities jointly with NASA employees.
4. It is a general policy of NASA not to recommend that employees "fight" fires except in cases where the fire is incipient in nature and extinguishable with the proper use of a portable fire extinguisher.

CHAPTER 10: INDUSTRIAL SAFETY

10.1 PURPOSE AND SCOPE

This Chapter is intended to address major industrial safety concerns, excluding fire protection which is discussed in Chapter 9. The major headings address issues which historically have contributed to catastrophic mishaps or a continuing level of high frequency and/or severity of occupational injuries. The Chapter omits reference to chemical, biological, and physical agents such as radiation, vibration, noise, health effects of toxic materials, heat stress, etc., which are under the purview of the NASA Occupational Health Office.

10.2 SAFETY IN THE CONCEPTUAL STAGE

The most fruitful safety effort is the recognition and assessment of risk in the concept stage of every program and operation. Safety is an integral part of the job at hand. A formal safety plan will be a part of every project or program plan, similar to finance, time, and logistics plans. Management must consider safety in the entire spectrum of employment, from employee selection, pre and on-the-job indoctrination, supervision, refresher training, review and discussion of new processes and procedures, safety implications of new equipment, and the safety impact of every change in the workplace.

10.3 PROJECT SAFETY REVIEWS

1. Safety project reviews will be conducted by personnel knowledgeable in the particular safety rules and standards applicable to the subject of the review for each plan or action involving rehabilitation, modification, acquisition, construction, or demolition of equipment and/or facilities. The cognizant safety official shall maintain a written record of these reviews and shall concur, if appropriate, with its conclusion that the action proposed is in accordance with NASA safety policies and standards.
2. For facility construction, modification, repair, and rehabilitation, compliance with the appropriate codes and standards is the responsibility of each field installation Facility Engineering Office. NASA fire protection and safety personnel shall monitor this compliance effort and involve themselves in the various phases of the facilities projects to assure compliance with fire and safety codes and standards. For projects costing over \$75,000, this involvement will be formal, with the safety office providing a formal sign-off. For projects costing less than this, the involvement may or may not be as formal depending on the impact of safety and fire codes and standards on the project (see also paragraph 9.4 of this handbook).
3. Assistance in conducting safety reviews of major program/projects/facilities is available from the NASA Operations and Engineering Panel (O&E Panel) whose membership is drawn from all Centers and Headquarters (see paragraph 1.6 of this handbook for further information).

10.4 HAZARDOUS MATERIALS

Hazardous material is defined by law as "a substance or materials in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce" (49 U.S.C. 1802). The Secretary of Transportation has developed a list of materials that are hazardous which may be found in 49 CFR 172.101. Typical hazardous materials are those that may be highly reactive, poisonous, explosive, flammable, combustible, corrosive, radioactive, produce contamination or pollution of the environment, or cause adverse health effects or unsafe conditions.

10.5 HAZARDOUS OPERATIONS

NASA hazardous operations are those that involve the use or handling of hazardous materials or involve the use of other materials, phenomena, or elements at abnormal environmental or physical parameters that could result in personnel injury or illness or property damage if special precautions are not followed (e.g., high pressure gas operations in excess of 150 pounds per square inch gage (psig), low pressure high volume gas operations, voltages above 550 volts, storage or handling of propellants or explosives, use of "heavy lift" material handling equipment, high or low temperature environments, environments with less than 19.5% or more than 25% oxygen by volume at normal atmospheric pressure, forced variations in gravity, excessive radiation, or excessive noise using national consensus standards or regulations as a guide).

10.6 HAZARDOUS OPERATING PROCEDURES (HOP's)

1. GENERAL

- a. Procedural error or lack of adequate procedures are primary events in the sequence of events leading to system mishaps. Knowledgeable preparation and strict adherence to operating procedures can prevent most of these mishaps.
- b. Each installation will identify which operations are considered hazardous and develop adequate safety and health controls. In general, all hazardous operations will require Hazardous Operating Procedures (HOP's), which are a detailed plan listing step-by-step functions or tasks to be performed on a system or equipment to ensure safe and efficient accomplishment of a particular operation. It is recognized that certain operations (e.g., rigging, high voltage, etc.) depend on adherence to overall standards and general guidelines as opposed to HOP's for each specific operation. In these cases, specific personnel certification requirements must be established as listed in Chapter 6. When this is the case, personnel other than the certified operators must be excluded from exposure to the operation. NOTE: The use of the specific nomenclature "HOP's" is not required. Local nomenclature that denotes safety or health critical procedures is acceptable.

- c. Field installations must document those hazardous operations for which personnel certification is a substitute for HOP's. There will be cases where both HOP's and certification will be necessary and none of the above precludes dual controls.

2. PREPARATION REQUIREMENTS

- a. HOP's shall be written in a manner which provides maximum protection to personnel, precludes procedural error, and minimizes misinterpretation.
- b. Those specific steps in which a malfunction or error will produce a reaction that could cause system degradation, personnel injury, or death shall be preceded by a precautionary note that shall be identified according to the following conditions:

WARNING

Maintenance or operating procedures, techniques, restrictions, etc., that may result in severe personnel injury, loss of life or major equipment damage if not followed exactly.

CAUTION

Maintenance or operating procedures, techniques, restrictions, etc., that may result in some damage to equipment or system or minor injuries to personnel if not followed exactly.

NOTE

Maintenance or operating procedures, techniques, restrictions, etc., that require emphasis for safe operation.

c. When it is determined that a critical or catastrophic event is possible due to component failures or malfunctions and/or personnel errors, HOP's shall include those steps to:

- (1) Assure the safety and health of personnel.
- (2) Specify actions to bring the emergency situation under control.
- (3) Specify actions and steps in detail to return the system(s) to nearest possible safe condition.

(4) Hazardous procedures shall be conspicuously marked hazardous on the title page to alert operators that strict adherence to the procedural steps and safety and health precautions contained therein is required to assure safety and health of personnel and equipment.

(5) All HOP's shall have an approval signature on the title page to certify that a review has been performed by the cognizant safety representative(s). Deviations from HOP's will require the approval of the cognizant safety and health representatives.

10.7 TRAINING

General safety training requirements for industrial occupations are included in Chapter 4. Specific personnel certification requirements, including training requirements for employees working in potentially hazardous occupations, are contained in Chapter 6 of this handbook.

10.8 PROTECTIVE CLOTHING AND EQUIPMENT

1. GENERAL

Protective clothing and equipment (PCE) will be issued to NASA employees at government expense in those situations where engineering controls, management controls, or other corrective actions have not reduced the hazard to an acceptable level or where use of engineering controls, management controls, or other techniques are not feasible.

2. PROCUREMENT

- a. Directors of Field Installations and the Director, Headquarters Administration Division, are authorized to purchase PCE after the purchase request has been reviewed by safety and/or health professionals to determine proper specifications and adequacy of abatement. It is recommended, but not required, that local safety and health committees be a party to the decision.
- b. The authority for the purchase of PCE with appropriated funds is 5 U.S.C. 7903.

- c. Only clothing or equipment meeting requirements of Federal regulations or industrial standards will be utilized.

3. ISSUANCE

- a. PCE will be issued to all NASA employees exposed to hazards in accordance with subparagraph 1. Accountability will be in accordance with NHB 4200.1, "Equipment Management Manual." Transients or visitors may be furnished PCE on a temporary basis if they are on site for NASA business purposes or at NASA's invitation. The host, guide, or area supervisor will be responsible for obtaining, issuing, and recovering the PCE. Other non-NASA, contractor and noncontractor personnel must procure their own PCE to provide an equivalent level of safety as required by NASA.
- b. PCE will be provided, used, stored, and maintained in accordance with 29 CFR 1910.132-1910.137 and stocked and issued as specifically directed in NHB 4100.1, "NASA Materials Inventory Management Manual."

4. EXAMPLES

Items which may be purchased and issued by NASA, include, but are not limited to, the following:

- a. Safety goggles and safety spectacles (plain and prescription).
- b. Welding helmets and shields.
- c. Safety shoes.
- d. Steel sole and/or toe safety boots.
- e. Aprons, suits, and gloves (e.g., fire resistant materials, leather, rubber, cotton, synthetics).
- f. Protective head gear (e.g., hard hats and caps, liners, helmets, and hoods).
- g. Barricades, traffic cones, flags, scaffolds, warning signs, alarms, lights, shields, and other public protective devices.
- h. Face shields.
- i. Speciality items of a protective nature (e.g., cryogenic handlers suits, metallic and/or reflective fire fighter suits, foul weather gear, harnesses, life belts, lifelines, life nets, insulated clothing for "cold test" exposure, supplied air suits, and electrical protective devices).
- j. Concentration alarms, poison gas indicators, explosive gas indicators.

5. HEALTH-RELATED PCE

Guidance for purchasing respiratory protective devices and other health related PCE will be issued by the NASA Occupational Health Office.

10.9 FACILITY DESIGN AND LAYOUT

1. GENERAL

Efficiency and safety in industrial operations can be greatly increased by careful planning of the location, design, and layout of a new plant or of an existing one in which major alterations are to be made. Catastrophes resulting in loss of life and substantial property damage are often due to inadequate planning-stage consideration of the physical and chemical properties of materials and processes.

2. STANDARDS

- a. While not an all inclusive list, the following standards applicable to new construction or rehabilitation/modification have a direct bearing on the ultimate safety of structures and observance is mandatory. Failure to review plans for compliance with these standards has led to costly retrofits after construction. Unless otherwise noted, the latest edition will be used.
 - (1) Uniform Building Code.
 - (2) National Electrical Code, National Fire Protection Association (NFPA) Standard No. 70.
 - (3) Life Safety Code, NFPA Standard No. 101.
 - (4) DOD Explosive Safety Standards, DOD 5154.4S and Chemical Propulsion Information Agency (CPIA) Handbook No. 194.
 - (5) American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Safety Code.
 - (6) American National Standards Institute (ANSI) Safety Code for Elevator, Escalator, Dumbwaiters, Moving Walks, A17.1.
 - (7) OSHA Standards, 29 CFR Part 1910, especially the following Subparts:
 - (a) Subpart D, Walking and Working Surfaces.
 - (b) Subpart E, Means of Egress.
 - (c) Subpart H, Hazardous Materials.
 - (d) Subpart L, Fire Protection.

- (e) Subpart M, Compressed Gas and Compressed Air Equipment.
 - (f) Subpart S, Electrical.
- (8) Indoor General Storage, NFPA Standard No. 231.
 - (9) Power Piping, ANSI B31.1.
 - (10) Chemical Plant and Petroleum Refinery Piping, ANSI B31.3.
 - (11) NHB 7320.1, "Facilities Engineering Handbook."
 - (12) Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People, as issued by the Architectural Transportation Barrier Compliance Board in 36 CFR 1190.

b. The following standards also bear strongly on the ultimate safety of the building and its occupants. These are advisory in nature:

- (1) Standard Practice for Industrial Lighting, ANSI/Illuminating Engineering Society, RP-7.
- (2) Standard Practice for Office Lighting, ANSI/I32.1.

10.10 FACILITY CONSTRUCTION

- 1. Construction activities are marked by hazardous conditions brought about by excavation activities; the presence of large and powerful machines; the difficulty of housekeeping; elevated work areas; congestion involving flow of materials; field fabrication; and quite often the presence of a multiplicity of contractors and other organizations. It is mandatory that safe practices be observed. Toward that end, at each NASA construction project a person will be designated responsible for the safety of operations. He/she will be empowered to stop unsafe operations and enforce corrective actions. Construction contracts will contain adequate safety provisions (see Chapter 3 of this handbook). Title 29 CFR Part 1926 is the OSHA Construction Safety Standard and will be followed for all NASA construction. EM 385-1-1, "Safety—General Safety Requirements," Corps of Engineers, U.S. Army, is mandatory for construction undertaken by the Corps of Engineers for NASA. For other construction projects it is considered advisory.
- 2. Activation of facilities involves the joint activities of the contractors and users of facilities. Hazardous conditions are often present because of the newness and/or complexity of equipment. It is mandatory that a designated person be responsible for safety during activation and that activation tests be duly reviewed for safety by properly qualified personnel.

10.11 FACILITY OPERATIONS MANAGERS OR COORDINATORS

1. Safety of personnel and facilities is the responsibility of line supervisors at all levels. The Field Installation Director or designee can appoint a facility operations manager or facility coordinator that has responsibility for overseeing proper operation of the facility. The degree of hazards involved and the scope of operations in the facility will be used to determine the need for a facility operations manager or coordinator. A facility safety coordinator may be appointed to assist the manager. The extent of each authority shall be detailed to insure complete safety coverage of all operations at the facility. The installation safety office will interface with the facility managers to assure proper safety program implementation.

2. The facility operations manager or coordinator is the focal point for safety planning, implementation and enforcement. Consideration will be given to the elimination of hazards, safety analyses, protective equipment and devices, and the presence of emergency equipment including first aid gear, emergency showers, and like items. Emergency plans are to be in effect and sufficiently practiced to assure adequacy. Procedural aspects are to include issuances of permits, conduct of inspections, and training of people.

10.12 INSPECTION AND PREVENTIVE MAINTENANCE OF TOOLS AND EQUIPMENT

1. The lack of an inspection program or the associated preventive maintenance is often the primary cause or a significant contributing factor in industrial accidents. Management is responsible for establishing an equipment inspection and preventive maintenance program. Items to be included are machine tools, hand tools, hoisting equipment, material handling equipment, and other tools or facility related items. There are three basic requirements for determining when preventive maintenance must be accomplished:
 - a. In accordance with prescribed NASA policies, including Federal regulations.
 - b. Manufacturer's recommendations or common industrial practice.
 - c. Special conditions of use or nonuse which may either accelerate or decelerate maintenance requirements.
2. The supervisor is responsible for prohibiting personnel from utilizing equipment which is malfunctioning or otherwise likely to cause or contribute to an accident and in instructing his/her personnel in the ways of reporting a malfunctioning piece of equipment.
3. The size of this task is of sufficient magnitude at most field installations to require the use of modern automatic data processing (ADP) equipment for inventory, preventive maintenance scheduling, and recordkeeping.

10.13 HOISTING APPARATUS AND RELATED EQUIPMENT

1. GENERAL

NASA utilizes a variety of hoisting devices from 1/4 to 250 ton capacity, which are often involved with hazardous material or mission critical hardware. The critical nature of the activities involved has dictated more stringent safeguards than may be utilized in normal industrial environments.

2. STANDARDS AND REQUIREMENTS

The following standards and requirements, as a minimum, are applicable to hoisting apparatus and related equipment used in NASA workplaces.

- a. NMI 5300.8, "Lifting Program Hardware in Manned Space Flight Operations."
- b. OSHA Standards, 29 CFR 1910.179-1910.182 and 1910.184.
- c. Personnel Certification for Critical Lift Crane Operators. See Chapter 6 of this handbook.
- d. NSS-GO-1740.9, "NASA Safety Standard for Lifting Devices and Equipment."

3. FIELD INSTALLATION REQUIREMENTS

Additional field installation requirements may be necessary. In addition, specific written HOP's (or equivalent) shall be maintained for each hoisting device and selected equipment which has a critical safety relationship as determined by the installation safety officer.

4. EQUIPMENT IDENTIFICATION AND RECORDKEEPING

All hoisting and related equipment shall be readily identifiable by a NASA equipment control number as applicable (see NHB 4200.1, "Equipment Management Manual"). Individual records shall be maintained detailing inspection and testing frequency and results, as well as modifications or repairs. (See also NSS-GO-1740.9, "NASA Safety Standard for Lifting Devices and Equipment.")

5. SPECIAL TESTING

The criticality attached to the hardware's use will often require more extensive testing, both in scope and frequency, for critical components that are single failure points (e.g., crane hooks). Detailed nondestructive evaluation (NDE) techniques for accomplishing such tests may be found in NASA SP-5113 entitled, "Nondestructive Testing."

10.14 PERSONNEL LIFTS

1. GENERAL

Because of the critical use of such personnel lifts such as High Ranger, Cherry Picker, Cloud 9, etc., adequate HOP's should be developed to assure proper operation. The HOP's should address wind restrictions, operating limits and instructions, restraint devices, inspections, etc.

2. STANDARDS

The following standards are applicable to personnel lifts:

- a. OSHA, 29 CFR Part 1910 Subpart F, "Powered Platforms for Exterior Building Maintenance."

- b. ANSI A90.1, "Manlifts."

10.15 BOILERS

1. TESTING INSPECTION

Details on testing and inspection of boilers are found in NMI 8833.1, "Boilers and Elevators Periodic Inspection."

2. OPERATING PROCEDURE

Written procedures are required for each boiler operation. These procedures shall clearly define routine steps in boiler operation and, in addition, shall identify emergency procedures and limitations necessary to preclude mishaps.

3. CALIBRATION

The proper functioning of gauges is critical to the safe operation of boilers and, as such, all critical gauges shall be included in the field installation's program for calibration. Local personnel will assess the criticality of each gauge. See NMI 5330.9, "Metrology and Calibration," for details.

4. STANDARDS FOR PREVENTION OF EXPLOSIONS

The NFPA has several standards (Nos. 85, 85B, 85D) that provide guidelines to prevent boiler mishaps. These guidelines contain information for gas, fuel oil, and coal fired boilers in both singular and multiple configurations.

5. MAINTENANCE OF SAFETY DEVICES

Safety devices, such as low water fuel shutoffs, will be properly maintained and checked at least annually to assure their proper functioning.

10.16 WELDING AND CUTTING

1. GENERAL

Welding and cutting operations combine many potentially serious hazards in a single operation. Examples of hazards are fire, explosion, radiation, toxic fumes, electrical shock, etc.

2. CERTIFICATION

Welders are in a Category II occupation for purpose of certification of personnel (see Chapter 6 of this handbook).

3. SAFETY STANDARDS

Safety standards for welding and cutting operations are found in the OSHA General Industry Standards, Subpart Q, 29 CFR 1910.251-1910.254.

4. SAFETY GUIDELINES

Additional information on safe procedures for welding and cutting operations may be found in the following National Institute for Occupational Safety and Health (NIOSH) publications:

- a. "Assessment of Selected Control Technology Techniques for Welding Fumes," NIOSH 79-125.
- b. "Engineering Control of Welding Fumes," NIOSH 75-115.
- c. "Safety and Health in Arc Welding and Gas Welding and Cutting," NIOSH 78-138.
- d. "Welding Safety," NIOSH 77-131.

10.17 PRESSURE VESSELS/SYSTEMS

Many of NASA's research operations involve the use of high or low pressure systems or systems that contain toxic materials that have a potential to cause serious injury or property damage in the event of rupture. NASA has instituted an inspection and testing program to recertify these systems to applicable safety codes. Requirements for the recertification program are provided in NMI 1710.3, "Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems."

10.18 MACHINE GUARDING

1. NEED

Improper machine guarding can be a major contributor to lost time injuries. The severity of those injuries may vary from minor abrasions to amputations and death. Many machines in the NASA inventory were

manufactured prior to the mandatory machine guarding requirements of the early 1970's. The necessity for guarding is nonetheless applicable. The use of machines which cannot be guarded through any of the several alternative guarding methods is to be discontinued.

2. REGULATIONS

Machine guarding standards are found in OSHA 29 CFR 1910.211-1910.219.

3. TYPES OF GUARDS

While guards are often thought of as being of the fixed type, others are available which include interlocks (mechanical, pneumatic, electrical, or combinations thereof), automatic types, presence sensing devices (photoelectric or radiofrequency), pullbacks, restraints, and two-hand trips or controls.

4. WAIVERS

Where a guarding arrangement is proposed which performs adequately but fails to meet specific requirements in an applicable standard, a waiver is required. To obtain such a waiver, the procedures contained in the handbook "Occupational Safety and Health Programs" will be followed.

10.19 MATERIAL SAFETY DATA SHEETS

1. All NASA procurement activities require the referencing of the Federal Standard for Preparation and Submission of Material Safety Data Sheets (MSDS) (Fed. Std. 313), as revised, in commodity specifications, purchase descriptions, purchase orders, contracts, and other purchase documents. The applicable blank forms for the MSDS will be provided by the NASA Occupational Health Office, NASA Headquarters, Code NPG.
2. The primary receiving office at each field installation shall ensure that MSDS's are received for all commodities requiring MSDS's as specified in Fed. Std. 313. The MSDS will be treated as a shipping document and a copy will be filed with the other shipping papers. Such offices will include the MSDS with the commodity when given to the user. MSDS's received for prior shipments can be applied to current and similar shipments.
3. Copies of the MSDS for shipment of such commodities shall be provided to the installation safety office and health office or to the central office responsible for maintaining the MSDS records, by the receiving office.
4. The safety and health office or other designated office will forward copies to the NASA Occupational Health Office, Code NPG.

10.20 CONFINED SPACES

1. DEFINITION

A confined space refers to a space which, by design, has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, and is not intended for continuous employee occupancy. Example includes storage tanks, process vessels, pits, silos, boilers, ventilation and exhaust ducts, tunnels, etc. Hazards which are often encountered include oxygen deficient atmospheres, presence of toxic vapors, flammable vapors, combustible dusts, uneven walking or working surfaces, limited egress routes, and unnatural and often poorly distributed lighting of the space.

2. REQUIREMENTS

Confined spaces that could pose a hazard to personnel (as determined by the safety or health officer) and require entry by personnel shall have written HOP's (or equivalent) which shall detail the requirements necessary to ensure the health conservation and safety of personnel based on the type and degree of hazard involved. Personnel shall use the approved entry procedures for entry into confined spaces.

3. NASA STANDARD

A NASA health standard entitled, "Entry Into and Work in Confined Spaces," soon to be published, will provide requirements to be followed in NASA workplaces.

4. RELATED STANDARDS

Related specific standards applicable to NASA welding and cutting operations involving confined spaces are found in 29 CFR 1910.252. More general requirements for entry into confined spaces are found in Subpart I-Personal Protective Equipment, especially the Section on Respiratory Protection, 29 CFR 1910.134.

5. GUIDELINES

NIOSH has published a criteria document for working in confined spaces (NIOSH publication No. 80-106, December 1979) which can assist in the development of HOP's (Hazardous Operating Procedures).

10.21 HANDLING AND STORAGE OF MATERIALS

1. Each installation will, as appropriate, have adequate safety procedures governing handling and storage of materials with particular emphasis on hazardous materials (e.g., propellants; cryogenics; gasoline; high pressure fluids; flammable materials; poisonous, toxic and radioactive materials; corrosives; explosives; acids; and similar materials).

2. Particular attention is to be given to proper spacing, adequate identification, color coding, environmental control, standard containers and qualifications and training of warehousing personnel.
3. The responsible manager is the Chief, Supply and Equipment Management Branch, NASA Headquarters.

4. Safety certification requirements for handlers of hazardous material are in Chapter 6 of this handbook.

5. For further information see NMI 4000.2c, "NASA Equipment Management."

10.22 PRODUCT SAFETY

1. GENERAL

The scope of NASA's operations often require the fabrication or modification of special equipment or vehicles in support of space, aeronautical, or ground programs or for particular industrial applications. When this occurs, NASA becomes a manufacturer as defined in 29 CFR Part 1960 and assumes responsibility for product safety.

2. REQUIREMENTS

Field Installations Directors shall establish product safety programs for locally designed and/or fabricated products which:

- a. Ensure that items procured or produced will allow employees to use such products safely for their designed purpose and will facilitate compliance with applicable standards.
- b. Requires that products meet the applicable safety and health requirements of Federal law and regulations issued thereunder.
- c. Ensure that hazardous material will be labeled in accordance with current laws or regulations to alert users, shippers, occupant(s) safety and health and emergency action personnel, and others, to basic information concerning flammability, toxicity, compatibility, first aid procedures, and normal as well as emergency handling and disposal procedures.
- d. Ensure availability of appropriate rescue and personal protective equipment to local users.
- e. Ensure that any defect or potential hazard identified in a product is corrected and a notice is prepared and distributed to all users. The GIDEP system (see NMI 5310.1 and NMI 5310.2) may be used.
- f. Includes preparation of Material Safety Data Sheets (MSDS), and coordinating with all interested personnel in the review to keep the information current. MSDS provided by agencies or contractors shall

meet the requirements of Fed. Std. 313 and be furnished to the NASA Occupational Health Office, NASA Headquarters, Code NPG, for filing and distribution.

3. GUIDELINES

The use of a system safety approach (see Chapter 7 of this handbook) can be of assistance in developing individual product safety reviews.

10.23 PHYSICALLY HANDICAPPED PERSONNEL

Management, personnel, and safety officials will assure that physically handicapped employees are placed in safe working conditions commensurate with their handicaps, and that adequate provisions exist for their safe entrance and egress at the work locations (see paragraph 10.9-2a(12) of this handbook).

10.24 PUBLIC SAFETY

1. GENERAL

NASA will strive to provide protection to the general public from the effects of NASA operations. This will include adequate safety precautions as well as adequate security restrictions.

2. RESPONSIBILITIES

- a. Field Installation Directors, Program Managers, and Officials-in-Charge of Headquarters Offices and line supervisors at all levels are responsible to assure that the public is not exposed to undue hazards as a result of NASA operations. If protection can be afforded through exclusion, adequate security measures will be imposed to limit public access and exposure. If protection must be afforded by safety restrictions, adequate precautions and controls will be implemented based on the hazards identified by analysis. Where the possible hazardous effects of NASA operations extend past the installation boundary, agreements may also be needed to control public access to the affected area.
- b. Officials should also establish cooperative programs with the local community including:
 - (1) Ensuring community awareness of the nature and extent of actual and potential hazards arising from the NASA operations and the measures being taken to protect the community.
 - (2) Development of joint disaster evacuation plans to include radiological contamination, explosive/propellant mishaps, toxic chemical spills, etc.
 - (3) Joint participation in community safety activities.

3. DAMAGE CLAIMS

Claims from the general public for damages arising out of NASA operations will be referred to the appropriate NASA legal or claims office. The safety official should be kept informed of these claims.

4. SPECIAL GUESTS

At times research personnel are allowed access to NASA facilities for purposes of individual research. These personnel are neither contractors nor visitors. It is important to assure that the research operations that they are conducting do not interfere with or damage NASA facilities or operations. If their work involves exposure to hazardous operations, the field installation safety or health official shall require them to follow all NASA precautions and to procure protective clothing and equipment at their own expense, if needed. Also, if they will be operating or using NASA equipment of a potentially hazardous nature, they will receive training and be certified as a qualified operator.

10.25 HAZARD ABATEMENT PROCEDURES

NASA has established hazard abatement procedures to comply with 29 CFR Part 1960. For more information and requirements on properly documenting and developing hazard abatement plans, see paragraph 4.7 of the handbook, "NASA Occupational Safety and Health Programs."

CHAPTER 11: AVIATION SAFETY

11.1 GENERAL

NASA's major involvement in aeronautics dictates an equally major involvement in aviation safety, not only under the NASA aviation safety program, but also under the technology programs as well. In either arena, aviation safety must be assured through a comprehensive and integral program covering all aspects of aviation.

11.2 PRINCIPLES

1. Aviation safety encompasses much more than the principle of accident prevention and reporting. It also includes the principle of safety enhancement. The first principle, that of accident prevention and reporting, involves application of risk assessment, hazard identification and control techniques, and adequate and responsive reporting. This principle deals with aviation safety as implemented in the contemporary sense and includes all aspects of flight activities.
2. The second principle, that of safety enhancement, is longer term in nature and involves the development and application of technology to improve aviation safety. This principle recognizes that, regardless of how well an aircraft is designed, there is ample room for improvement through research. In either case, a balanced Aviation Safety Program must include these principles.
3. In either case, it is essential that the tried and proven precepts of flight test and other aircraft operations developed over the years of aviation evolution be applied, particularly where research is involved. The adherence to the principles and requirements defined herein are considered essential to a viable aviation safety effort. Center policy and procedural documents should reflect these and other precepts appropriate to enhance aviation safety.
4. All aviation program personnel will ensure that programs include adequate safety provisions. To do this, they may call on safety officials for the guidance and support required. Emphasis should be placed on the development of aviation safety enhancement techniques, standards, and procedures. Application of these tools must be tailored to NASA needs, so as to insure not only adequate safety, but also successful mission completion.

11.3 SCOPE

NASA flight activities range from the esoteric and experimental, designed to expand the boundaries of knowledge, to that of the more mundane support and administrative. These flight activities may be piloted or unpiloted and are conducted from numerous geographically displaced airfields and sites around the world often in conjunction with one of the services of the DOD or at public airfields. The diversity of NASA activities indeed challenges a viable Safety Program and demands constant vigilance, flexibility, and responsive

techniques to assure safe and successful operations. The responsibility for aviation safety is jointly shared by the program office and the Center Director. In discharging this responsibility, the minimum requirements stated herein will be followed.

11.4 AVIATION SAFETY OFFICIALS/COMMITTEES/RESPONSIBILITIES

1. The Program Office is responsible for establishing and reviewing the approved programmatic requirements.
2. The Office of the Chief Engineer is responsible for the overseeing flight safety.
3. The Center Director is responsible for determining the specific airworthiness and flight readiness review requirements and operating procedures and for ensuring that the flight objectives satisfy the programmatic requirements.
4. The Intercenter Aircraft Operations Panel will establish review teams to periodically review all aspects of aircraft operations at the NASA Centers, including the implementation of Center procedures.
5. The NASA Transportation and Aircraft Branch working with sub-panels of the Intercenter Aircraft Operations Panel will be responsible for establishing the airworthiness reviews and standard operating procedures for all aircraft.
6. An Aviation Safety Official (ASO) will be appointed at each appropriate field installation by the Center Director. The ASO will serve as the focal point on all aviation safety matters and act in behalf of the Center Director when discharging this responsibility. The ASO should therefore report directly to the safety director, senior flight operations official, or higher level management.
7. The ASO will have a sufficiently adequate background in aviation and familiarity with the installation and its ongoing programs in aviation to execute and promote an effective safety program. The ASO will foster aviation safety measures and use all resources available to assure, in conjunction with ground safety, timely, energetic, and responsive accident prevention and reporting.
8. The formation of ad hoc or standing committees to assist in carrying out the functions of aviation safety such as in design, flight readiness, or aviation safety reviews is encouraged.

11.5 INTERFACES WITH OTHER AGENCIES

1. GENERAL

NASA aviation, by its inherent nature, has interfaces with the aircraft industry during purchase, tests, and maintenance with the Department of Transportation for the Federal Aviation Administration (FAA) research

and development projects and with the Department of Defense regarding military aircraft, use of military facilities, and logistics support. These resources will be fully utilized in matters of aviation safety.

2. INDUSTRY

Although the interface is normally through the contracting officer, special safety provisions in contracts should permit and/or require exchange of accident information concerning the types of aircraft involved. The safety officials should participate in design reviews and inspections during the acquisition phase to assure proper safety coverage.

3. DEPARTMENT OF TRANSPORTATION

NASA aviation safety has a direct interest in FAA flight services for facilities used by NASA aircraft. These include the airways, departure and arrival procedures, restricted airspace, and local flying/training areas. Cooperation with FAA at the local level will enhance a mutual understanding in developing safe aviation control procedures. In R&D, a real opportunity exists for NASA/FAA cooperation to enhance safety.

4. DEPARTMENT OF DEFENSE

Since NASA utilizes many military airfields and aircraft common to the military services, coordination with the Army, Navy, and Air Force is very desirable. Use of the various service safety publications, cross-exchange of accident prevention data and participation in joint safety efforts will be of mutual benefit. Safety and accident investigation provisions are included in joint agreements with DOD agencies for joint use or loan aircraft situations (see Chapter 2 of this handbook).

11.6 INFORMATION EXCHANGE

The timely receipt and dissemination of important safety information is a key element in accident prevention and enhancement of safety. Each NASA employee should report potential or actual aviation-related hazards to the ASO who is responsible for prompt formal or informal notification of other safety groups. This and other safety information should be further disseminated through meetings, posters, notices, or some other form to all interested parties at all levels.

11.7 THE AVIATION SAFETY REPORTING SYSTEM

1. A major program jointly sponsored with the FAA is the NASA Aviation Safety Reporting System (ASRS). The Office of Management and Budget (OMB) Report Control No. is 04-R-9206 which has been assigned to Ames Research Center Form 77. This program is designed to identify and publicize deficiencies/discrepancies which have potential safety impact on the aviation community. The program does not address accident reports but rather solicits perceived safety hazards through a system of protected reporting. This system receives, stores, and distributes

important data. It also analyzes the data and conducts special studies and reports on the results.

2. All ASO's should use the services of the ASRS program, support its objectives and integrate the program's output into their local Aviation Safety Program. They should encourage pilots and other members of the aviation community to submit timely reports of hazardous conditions or incidents as prescribed under the ASRS programs.

11.8 AIRCRAFT MISHAP REPORTING AND INVESTIGATING

For aircraft investigations and report requirements, see Chapter 2 of this handbook.

11.9 PROCEDURES

Considering the diverse nature of all aircraft operations within NASA, certain elements and functions that are fundamental must be included as an integral part of all NASA aircraft operations. All NASA installations will ensure that the following elements and functions appear within their written policy and procedures covering flight/flight test operations:

1. Establish and document the programmatic need and justification for all flight activities involving NASA programs, aircraft, and/or personnel. Activities not satisfying this requirement will not be conducted.
2. Establish an organization or review board(s) specifically for airworthiness reviews, that will, using a multidisciplinary system-type approach, function independent of line management. These reviews are to be formally conducted and documented.
3. All aircraft flight projects or missions (especially those involving aircraft modifications or changes in flight envelopes or operating procedures) will be subject to the airworthiness review process. Normally, a research flight program is reviewed/approved in total and then implemented using individual flight test plans that receive their own review/approval.
4. Flight programs should be reviewed as early in the development cycle as possible and should identify the need and schedule for additional resources, procedures, or reviews.
5. The availability and qualifications of personnel should be reviewed and any special training needs or requirements established.
6. Local procedures and documentation for configuration control and airworthiness/quality assurance should be established.
7. Local procedures should include monitoring of all research/test flights (e.g., radio communications, chase aircraft, etc.).

8. Safety review procedures will be established at each installation that will, as a minimum, include an aviation safety function that:
 - a. Is normally assigned to a qualified pilot as a collateral duty.
 - b. Includes oversight of both ground and flight operations.
 - c. Reports accidents and significant aircraft mishaps to the proper persons through established channels.
 - d. Allows unrestricted capability to report directly to Center management.

11.10 SURVEY REQUIREMENTS

1. The Intercenter Aircraft Operations Panel will review all aspects of aviation operations at least every 2 years at those Centers involved in aircraft operations. Self evaluation will be conducted in the intervening years. The purpose of the review will be the objective evaluation of aircraft operations, maintenance, crew procedures, and facilities to ensure safety and efficiency of operation and consistency of aircraft usage with assigned goals and Center requirements. The results of the review will be used to update NASA policies and instructions and improve productivity through standardization and exchange of information.
2. The aviation safety reviews will include all aircraft operations, aircrew practices and facilities, airfield facilities, maintenance, and any other items having an impact on aviation safety or efficiency. The Manager, Aviation Safety, Office of the Chief Engineer, NASA Headquarters, will be appointed as a member of the review team. In the event that a biennial review is not possible by a team sponsored by Headquarters, a third-party Center team should be constituted to perform the review and report findings to NASA Headquarters. When aviation operations are contracted, the contract should provide for periodic safety review of the contracted operations, personnel, and facilities.

11.11 FLIGHT RULES AND RESTRICTIONS

Each manager of flight operations will acquire/publish, keep current, and assure understanding and compliance with flight rules, regulations, and other advisory material required for safe flight operations. Where local conditions or special mission requirements dictate, special rules/procedures should be established and followed. Restrictions to flight, Notice to Airmen (NOTAM), or other pertinent information will be readily available and briefed prior to initiation of flight operations.

11.12 *AIRCRAFT TRAINING AND STANDARDIZATION

Aircrew checkout and currency training are essential to a successful Aviation Safety and Accident Prevention Program. This is particularly true in fulfilling the NASA mission where exposure to a variety of different aircraft, many of which are unique in character or possess unusual systems, is normal. Transfer

of proficiency from one aircraft to the next should never be presumed. Standardization within the bounds of practicality and copious use of checklists and similar aids will be instituted. Review of these and other training procedures and practices will be performed to assure currency.

11.13 OCCUPATIONAL HEALTH, MEDICAL CLEARANCE, EMERGENCY EGRESS, AND SURVIVAL

1. Close coordination with occupational health officials and aviation personal equipment specialists shall be maintained to assure that proper medical clearances for flight duties are obtained and aircrews and passengers are protected through adequate training and availability of equipment for emergency survival equipment. The proper care and use of parachutes, egress systems, breathing equipment, protective equipment, and survival gear are subjects for safety surveillance.
2. Training in the latest information and procedures for egress and survival should be provided in a timely manner. This is particularly important when new equipment is received and when procedures are updated to new standards. Knowledge of egress capabilities at high speed and high altitudes, as well as low altitudes and high sink rate conditions, is of vital importance to operators of high performance as well as Vertical/Short Take-Off and Landing (V/STOL) aircraft. Training in passenger briefings is important for crews of administrative aircraft. The ASO should assist in this type of training.

11.14 FACILITIES

Adequate facilities pertaining to flight will be established and maintained. These include aircrew, airfield, and maintenance facilities. If off-site operation is planned, emergency facilities must be defined and provided.

11.15 CARGO SAFETY

Provisions shall be made for the safe handling and stowing of cargo, including hazardous materials in NASA aircraft. Additionally, contract carriers and airlift services, utilized by NASA will be required to abide by sound safety practices and Department of Transportation (DOT) regulations in the transportation of hazardous materials and cargo. Mixed cargo and passenger loads will be monitored for safe practices by those responsible (see also Chapter 12 of this handbook).

11.16 NEW AIRCRAFT DEVELOPMENT

For new aircraft, the system safety approach should be applied for hazard analysis early in the acquisition process. The ASO shall monitor the program for signs of new problems or hazardous conditions throughout the useful life of the aircraft. Analysis of problem areas or research into hazardous conditions shall be initiated whenever conditions indicate an unacceptable level of risk. Research and development (R&D) flight tests are more hazardous than other flying activities; therefore, the added risks of research flying should be considered and provided for in the evaluation to assure that the test is accomplished under the safest possible conditions.

CHAPTER 12: MOTOR VEHICLE AND TRANSPORTATION SAFETY

12.1 GENERAL

The purpose of this chapter is to provide guidance and requirements that will help in preventing or reducing motor vehicle caused accidents, injuries, and property damage and to outline requirements for transportation safety.

12.2 DEFINITIONS

1. MOTOR VEHICLE

A motor propelled vehicle of a commercial design that is used for the purpose of providing transportation support (personnel and cargo) and is capable of being licensed by the State or local authority having jurisdiction. (Examples are automobiles, pick-up trucks, buses, stake trucks, vans, etc.)

2. GOVERNMENT VEHICLE

A NASA owned or other U.S. Government agency owned motor vehicle being used in support of NASA operations. Privately owned motor vehicles, when being used by NASA personnel during temporary duty (TDY) or for official business on a reimbursable basis, will be subject to the same requirements as government vehicles. Vehicles operated under contract by non-NASA personnel are excluded unless these requirements are specified in the contract.

12.3 APPLICABILITY

The requirements of this chapter are applicable to all NASA drivers and passengers of Government vehicles and to NASA personnel engaged in transportation operations on land, sea, or in air.

12.4 MOTOR VEHICLE SAFETY

1. LICENSING

The Office of Personnel Management requires that a government employee who operates a government-owned motor vehicle must have an identification card (SF-46) issued in accordance with Federal Personnel Regulations. The detailed NASA requirements for the mandatory government licensing of drivers are contained in NMI 6720.1, "NASA Motor Vehicle Management." The exception is an employee who must occasionally use a government-owned, leased, or rented automobile for official business while on TDY away from his/her official duty station does not need an operators identification card providing he/she holds a valid state license. Contractor personnel are required to have a valid state or equivalent license prior to operating NASA motor vehicles.

2. OPERATING REQUIREMENTS

a. Use of lap (seat) belts/shoulder belts.

- (1) The one single preventive measure that has been shown to reduce or prevent personal injury in most motor vehicle accidents is the use of seat belts/shoulder belts. Accordingly, all occupants of a government motor vehicle equipped with seat or seat/shoulder belts in accordance with DOT or OSHA requirements will properly adjust and wear the belts while operating or riding in the government vehicle. Children unable to use the belts will be placed in the rear seats only, unless infant seats are available and used. Small children should never be held on laps of adults in the front seat as a method of providing crash protection, as tests have shown that they are crushed between the adult and the car interior in event of a forward crash.

- (2) The requirements to keep unbuckled children in the rear seats or in infant seats applies at all times. The requirement for use of belts is not mandatory for the individual involved if any of the following conditions are met:

- (a) The motor vehicle is not equipped with lap and shoulder safety belts, in accordance with DOT or OSHA exclusions.
- (b) The vehicle frequently stops and the individual frequently leaves the vehicle or delivers property from the vehicle and the speed of the vehicle between stops does not exceed 24 kilometers (15 miles) per hour.
- (c) The individual possesses a written indication from a physician that they are unable to wear a seat or shoulder belt for medical or physical reasons.
- (d) The individual possesses a certificate or license endorsement issued by a state motor vehicle department, or a similar agency in another state or country, indicating the individual is unable for medical, physical, or other valid reasons to wear a seat or shoulder belt.
- (e) The use of the seat or shoulder belt would interfere with operation of the vehicle and is so certified by the Field Installation Safety Director.

b. Unloading/Loading People

Vehicle will come to a complete stop before passengers are allowed to disembark or load. Vehicles will not be put in motion until the driver has determined that all passengers are properly seated, required restraint devices fastened, and all doors closed. This also

includes side plug doors and rear doors in vans unless special circumstances such as carrying oversize loads prohibits closing of the doors.

c. Backing Operations

When rearward visibility is impaired due to obstructions or vehicle configuration, ground guides will be used for assistance in all backing movements in restricted or confined locations.

d. Carrying Additional Passengers

- (1) No more than three people will be allowed in the front seats of NASA vehicles.
- (2) In pick-up trucks or other trucks with a flatbed and sides, additional people can be carried in the bed if:
 - (a) All persons are seated on the bed floor during motion.
 - (b) All extremities of the persons are completely inside the bed.
 - (c) The tailgate is closed.
 - (d) The speed is 25-miles per hour or less.

3. VEHICLE INSPECTION

- a. If the state or other jurisdiction in which the field installation is located has a vehicle safety inspection program, then all installation motor vehicles licensed for road use will comply with or be inspected to those standards.
 - (1) Exhaust systems.
 - (2) Brakes.
 - (3) Tires.
 - (4) Lights/Wipers/Horn.
 - (5) Steering.
 - (6) Passenger restraint devices or other restraint system when equipped.
- b. If no state inspection program exists, then, all installation motor vehicles licensed for road use, as a minimum, will be checked by qualified personnel under the direction of the the installation motor vehicle operations officer on an annual basis to determine correct operation, proper sealing, or adequacy of the following:
 - (1) Exhaust systems.
 - (2) Brakes.
 - (3) Tires.
 - (4) Lights/Wipers/Horn.
 - (5) Steering.
 - (6) Passenger restraint devices or other restraint system when equipped.

(7) Fuel, coolant, and oil systems (lack of excessive leaks).

4. TRAINING

- a. All personnel that are assigned to operate motor vehicles will receive an initial briefing and instruction in the peculiarities of the vehicle. This may be conducted by the supervisor or field installation motor vehicle operations officer or designee.
- b. If operation of the vehicle involves additional skills above those associated with normal everyday operation of private motor vehicles, formal initial training, consisting of both classroom and road testing, should be conducted to assure operator familiarity with the vehicle. The extent of this training will be determined by the field installation motor vehicle operations officer or designee.
- c. Remedial or refresher training may be administered if personnel exhibit a tendency to have motor vehicle related mishaps.

5. TRAFFIC CONTROL DEVICES AND MARKINGS

The Manual on Uniform Traffic Control Devices, ANSI D6.1, will be used for guidance when setting traffic control devices or marking roads for motor vehicle operations on NASA property.

12.5 TRANSPORTATION SAFETY

1. GENERAL

A comprehensive transportation and logistics safety approach shall be pursued which provides for the protection of persons and property. This will include establishing goals and objectives, developing and establishing a management system for planning, implementing, coordinating, evaluating, and controlling the effort, and developing appropriate safety requirements, standards, procedures, and criteria for facilities, equipment, and operations.

2. BACKGROUND

- a. A complex set of laws and regulations relating to transportation and safety govern commercial shipments made by NASA and its contractors. The Federal, state, and municipal governments have established requirements governing not only the transportation of hazardous and dangerous shipments in their areas of jurisdiction, but they have imposed standards on the use, operation, and maintenance of transportation equipment, aircraft, ships, rail, highway, and pipelines for both passenger and cargo use. Applicable publications include those of Department of Transportation (DOT), Federal Aviation Administration (FAA), and Federal Railroad Administration (FRA).

- b. The tight time schedule associated with the large R&D projects, coupled with the movement of dangerous, critical, and sensitive cargoes, demand that every effort be made to assure complete transportation safety, including compliance with applicable laws and regulations.

3. ADMINISTRATIVE AIRCRAFT, MARINE, AUTOMOTIVE, AND OTHER REQUIREMENTS

- a. Specific rules and regulations promulgated by NASA (see NHB 6200.1, "NASA Transportation and General Traffic Management"), other Federal agencies, and state and local governments shall be adhered to in all NASA and, where applicable, contractor operations.
- b. **Administrative Aircraft.** Administrative aircraft requirements are treated in a special handbook, NHB 6540.2, "Administrative Aircraft Operations Manual," which interweaves safety into operations, maintenance, and training. The Intercenter Aircraft Operations Panel reviews field centers for compliance with these requirements. Reviews encompass all air operations, including airfield, communications, navigation equipment, personnel, machinery, and management controls. For further and more detailed discussion of this subject, see Chapter 11.

- c. **Marine.** In the marine field, NASA follows the U.S. Coast Guard regulations. It imposes more stringent requirements on the marine contractors for safety of personnel, launch vehicle stages, and cryogenic cargoes. In the ocean area, the Navy's standards are found to be highly effective.

- d. **Vehicular.** For vehicular movements, applicable DOT requirements will be followed as well as NMI 6720.1, "NASA Motor Vehicle Management."

4. INSPECTION OF NASA EQUIPMENT USED TO TRANSPORT HAZARDOUS MATERIAL

All NASA motor vehicles, aircraft, rail cars, and ships used for transportation of hazardous material will be inspected prior to loading to ensure that the vehicle is in a safe mechanical condition. The vehicle, vessel, or craft will be inspected to the applicable standards such as those of Federal Highway Administration, U.S. Coast Guard, and Federal Railroad Administration, etc. Other vehicles transporting nonhazardous cargo will be inspected on a regular schedule. For a definition of hazardous material, see Chapter 10.

5. REPORTING OF ACCIDENTS DURING TRANSPORTATION OF HAZARDOUS MATERIALS

- a. In general, contracted commercial carriers are responsible by law for reporting all accidents involving transportation of hazardous

material. If only NASA personnel and equipment are being used and the accident involves hazardous material and occurs in the public domain, it is NASA's responsibility to report the accident. The circumstance of the accident must be reported as soon as possible by telephone to the DOT Accident Hotline (toll free 800-424-8802) if it involves:

- (1) A fatality;
 - (2) A person requiring hospitalization as a result of injuries received;
 - (3) Estimated property damage exceeding \$50,000;
 - (4) Possible existence of radioactive contamination; or
 - (5) A continuous danger existing at the site.
- b. The Headquarters NASA Safety Division will also be notified of the circumstances of the accident and will assure that DOT has been notified. A written followup report must be sent to the Associate Director for Hazardous Materials Regulations, DOT, Washington, D.C. 20590, within 15 days as stated in 49 CFR 171.16. A copy of the report will be provided to the NASA Safety Division, Office of the Chief Engineer, NASA Headquarters.

- c. Chapter 2 of this handbook provides further guidance on mishap reporting and investigation.

6. DRIVER/OPERATOR TRAINING

Drivers or operators of vehicles transporting hazardous materials will be instructed:

- a. In the specific hazards of the cargo or material in their vehicle and the standard emergency first-aid procedures that should be taken in the event of a spill or exposure to the hazardous material.
- b. In their responsibilities for reporting accidents and providing follow-on reports as stated in subparagraph 5.

CHAPTER 13: SAFETY IN UNDERWATER OPERATIONS

13.1 GENERAL

Safety in underwater operations requires the application of the principles of a sound industrial safety program. Additionally, due to the need for continuous risk control and assurance of employee protection in an underwater workplace environment, specific controlling standards must be adopted and applied to the development of rigorous, disciplined procedures for personnel training, equipment inspection and maintenance, standard operations, and specific task operations.

13.2 APPLICABILITY

Underwater operations addressed by the requirements in this chapter apply to all NASA operations where employees are required to work or train in water using underwater or special apparatus which supplies compressed breathing gas at ambient pressure and related support operations in connection with procedurally defined tasks either in open water or fabricated vessels. It applies to diving conducted within and deeper than the no-decompression limit, to divers in self-contained underwater breathing apparatus (SCUBA), heavy gear, umbilical outfits, and diving bells, and to training operations. It does not apply to operations conducted from vessels under U.S. Coast Guard jurisdiction.

13.3 STANDARDS

1. The OSHA requirements in 29 CFR Part 1910, Subpart T, apply to all NASA underwater operations, except those operations governed by U.S. Coast Guard (USCG) Regulations.
2. The USCG requirements in 46 CFR Part 197 shall apply to all NASA underwater operations taking place from vessels and facilities under USCG jurisdiction.
3. For unique operations involving equipment and methodology not addressed by the OSHA or USCG standards, standards or procedures shall be developed by the installation based on consensus standards and good practice techniques to supplement and complement the OSHA or USCG standards. Supplemental standards must be approved. Guidance for obtaining this approval is contained in NHB 2710.1, "NASA Occupational Safety and Health Programs."

13.4 PERSONNEL REQUIREMENTS

1. OPERATIONAL REQUIREMENTS

- a. Each diver must meet qualification requirements through training and experience to perform both the assigned individual and team member tasks in a safe and healthful manner.

- b. All diving will be conducted using the buddy system (assigned pairs). No diver will be allowed to dive alone, except in emergency or rescue situations when a human life is in danger and then only on a volunteer basis. The diver must be either under direct visual observation or tethered.

- c. Certification shall be required for all dive team members as stated in Chapter 6.

2. MEDICAL REQUIREMENTS

Each dive team member shall be examined at least annually to determine if medically fit to perform assigned tasks. The examination will be conducted by a physician knowledgeable of the nature and extent of hyperbaric conditions to which the dive team member will be exposed, including diving modes and types of work to be assigned. An examination will also be conducted prior to initial hyperbaric exposure and after an injury or illness requiring hospitalization of more than 24 hours.

2. TRAINING REQUIREMENTS

Training, incorporated into formal courses to the extent practical, shall be provided for each dive team member in the following:

- a. The use of tools, equipment, and systems relevant to assigned tasks.
- b. Techniques and procedures of the assigned diving mode(s), including the buddy system concept and underwater communication.
- c. Diving operations, including diving-related physics and physiology.
- d. Emergency procedures, including cardiopulmonary resuscitation and first aid.

13.5 EQUIPMENT REQUIREMENTS AND SPECIFICATIONS

1. BREATHING GASES

- a. Respirable air for the divers will meet the requirements for Grade E type air as established in Compressed Gas Association pamphlet G-7.1-1973 as a minimum.
- b. Respirable oxygen for the divers will meet the United States Pharmacopeia Standard for Medical or Breathing Oxygen as a minimum.
- c. Breathing gas will meet the specifications in 46 CFR Part 197 for operations under Coast Guard jurisdiction.

2. EQUIPMENT

- a. All equipment covered by the OSHA or USCG diving standards will comply with the applicable OSHA or USCG requirements, respectively.
- b. All equipment not covered by the OSHA or USCG standards such as that used in support of shallow water SCUBA instruction, search and rescue, etc., will comply with industry consensus standards, good practice standards, or as much of the OSHA or USCG standards as are determined necessary by the cognizant safety director.
- c. All discrepancies in equipment that are noted during a dive will be documented and corrected prior to any additional dives.

13.6 GENERAL OPERATING PROCEDURES

1. A Safe Practices Manual shall be developed, maintained, and available to each dive team member at the underwater operations location. In addition to a copy of applicable standards and a general information or requirements section, the manual shall include the following:
 - a. Specific procedures and checklists for each diving operation.
 - b. Responsibilities of the dive team members and support personnel.
 - c. Equipment procedures and checklists.
 - d. General emergency procedures, including rescue techniques, medical treatment, etc.
2. The specific operating procedures discussed in subparagraph 1a will outline requirements during each of the three phases of a dive: pre-dive, dive, and post-dive.
 - a. The pre-dive phase shall include planning, safety assessment, identification, and inspection of equipment and supplies.
 - b. The dive phase shall include water entry and exit, communications, dive profiles and limits, individual and crew responsibilities, decompression tables (as appropriate), tools and equipment, use of hazardous materials, dive termination under normal and emergency conditions, and use of support and rescue equipment.
 - c. The post-dive phase shall include checks on physical conditions of the divers and other precautions necessary following diving, the record of dive, record of equipment malfunctions, and, as required, recompression capability and decompression procedure assessment.
3. A diver and crew briefing will be conducted prior to the dive by a knowledgeable person, familiar with the safety requirements and operational aspects of the dive. As a minimum, the briefing will include a review of:

- a. The applicable portions of the Safe Practices Manual.
- b. The specific operating procedures and individual diver and crew responsibilities.
- c. Dive profiles and operational limits.
- d. The buddy system (no one dives alone), assignment of pairs, and communication techniques.
- e. Special emergency and rescue procedures and responsible personnel.

13.7 RECORDKEEPING

1. Records, reports, and other documentation which are pertinent to the safety and health of employees in underwater operations shall be prepared and maintained in accordance with an established schedule which includes at least the requirements specified in 29 CFR 1910.440, unless covered in subparagraph 2. Records will be kept of all maintenance actions on the diving equipment and support apparatus. Copies of all records will be available for the employees to review, subject to Privacy Act requirements.
2. Diving operations under USCG jurisdiction will maintain records as required by USCG Regulations in 46 CFR Part 197. Copies of these records will also be made available to the employees for their review, subject to Privacy Act requirements.

EMPLOYEE TRAINING SCHEDULE

1981 - 1982

EMPLOYEE CLASSIFICATION	1981				1982			
	1st QUARTER	2nd QUARTER	3rd QUARTER	4th QUARTER	1st QUARTER	2nd QUARTER	3rd QUARTER	4th QUARTER
LABORATORY WORKERS								
MOTOR VEHICLE DRIVERS								
MATERIALS HANDLERS								
OFFICE WORKERS								
TO BENZENE EXPOSED WORKERS								

**EMPLOYEE TRAINING SCHEDULE
1981 - 1982**

1st QUARTER		2nd QUARTER		3rd QUARTER		4th QUARTER	
MANAGEMENT	UL EMPLOYEES	SAFETY TIPS IN NEWSLETTER	DISTRIBUTION OF LITERATURE ON MANAGEMENT RESPONSIBILITIES	OFFICE SAFETY AND FIRE PROTECTION INFORMATION TO OFFICES AND FIRING ROOMS	OFFICE SAFETY INFORMATION OF SAFETY HEALTH INFORMATION	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES
SUPERVISORS	NEW EMPLOYEES	SAFETY TIPS IN NEWSLETTER	DISTRIBUTION OF LITERATURE ON MANAGEMENT RESPONSIBILITIES	OFFICE SAFETY AND FIRE PROTECTION INFORMATION TO OFFICES AND FIRING ROOMS	OFFICE SAFETY INFORMATION OF SAFETY HEALTH INFORMATION	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES
C.D. PERSONNEL	MANAGEMENT	SAFETY TIPS IN NEWSLETTER	DISTRIBUTION OF LITERATURE ON MANAGEMENT RESPONSIBILITIES	OFFICE SAFETY AND FIRE PROTECTION INFORMATION TO OFFICES AND FIRING ROOMS	OFFICE SAFETY INFORMATION OF SAFETY HEALTH INFORMATION	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES
REPRESENTATIVES	UL EMPLOYEES	SAFETY TIPS IN NEWSLETTER	DISTRIBUTION OF LITERATURE ON MANAGEMENT RESPONSIBILITIES	OFFICE SAFETY AND FIRE PROTECTION INFORMATION TO OFFICES AND FIRING ROOMS	OFFICE SAFETY INFORMATION OF SAFETY HEALTH INFORMATION	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES
ENTRANCE	MANAGEMENT	SAFETY TIPS IN NEWSLETTER	DISTRIBUTION OF LITERATURE ON MANAGEMENT RESPONSIBILITIES	OFFICE SAFETY AND FIRE PROTECTION INFORMATION TO OFFICES AND FIRING ROOMS	OFFICE SAFETY INFORMATION OF SAFETY HEALTH INFORMATION	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES	INFORMATION AS PART OF FIRE PREVENTION WEEK ACTIVITIES
1st QUARTER	1981	2nd QUARTER	1981	3rd QUARTER	1982	4th QUARTER	1982

APPENDIX B

SAFETY /HEALTH CAREER DEVELOPMENT TRAINING PLAN

NAME	TITLE	GRADE
JOHN DOE	SAFETY SPECIALIST	GS-11
PLANNING PERIOD: 1981-1982	content	
SUBJECT/COURSE "ACCIDENT INVESTIGATION"	TECHNIQUES OF INFORMATION COLLECTION, ACCIDENT RECONSTRUCTION, CAUSE ANALYSIS, INTERVIEW TECHNIQUES, WITNESS STATEMENTS, TECHNIQUES OF PHOTOGRAPHY.	
LOCATION OSHA TRAINING INSTITUTE		
DATE 2/19/81 - 2/27/81		
SUBJECT/COURSE EXPLOSIVES SAFETY	content	
LOCATION CENTER	CORRESPONDENCE COURSE SUPPLIED BY DEPT. OF ARMY COVERING BASIC EXPLOSIVES SAFETY.	
DATE 8/4/81 - 8/1/82		
SUBJECT/COURSE "AUTOMATIC SPRINKLER SYSTEMS"	content	
LOCATION HOWARD COMMUNITY COLLEGE	COVERS SPRINKLER SYSTEM TYPES AND DESIGN THEORY, HYDRAULIC CALCULATIONS, NFPA STANDARD NO. 13.	
DATE 9/1/81 - 12/3/81		
SUBJECT/COURSE AEROSPACE SAFETY	content	
LOCATION CENTER	RESEARCHED LITERATURE TO DEVELOP THE TOPIC FOR A PAPER TO BE PUBLISHED IN A SAFETY JOURNAL.	
DATE 1/1/82 - 3/1/82		
SUBJECT/COURSE INDUSTRIAL HYGIENE FOR SAFETY OFFICERS	content	
LOCATION OSHA TRAINING INSTITUTE	CONCEPTS AND PHILOSOPHY OF INDUSTRIAL HYGIENE, COVERS I.H. FIELD OPERATIONS MANUAL AND EVALUATION OF SELECTED HAZARDS BY USE OF INSTRUMENTS.	
DATE (UNKNOWN) SUMMER, 1982		
APPROVAL <i>Howard Bonghe</i>	TITLE SAFETY DIRECTOR	DATE 10/3/80

